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The new Rapid Transit Commission of New York city completed its organization on June 18 by the election of Mr. L. L. Delafield as Secretary, Messrs. Henry R. Beekman and A. B. Boardman as Counsel, and Mr. W. B. Parsons, M. Am. Soc. C. E., as Chief Engineer. The offices of the Commission will be in the Home Insurance Building, 256 Broadway.

The St. Louis Subway Commission has prepared an ordinance which declares that the safety of the lives and property of the citizens requires that the network of wires now strung overhead in the streets of the city should be placed underground. It provides for the construction of subways, authorizing the city to become lessee thereof, operate the same, and sublet ducts. As provided in the ordinance, all the overhead wires in the district bounded by Cass Ave., Choteau Ave., the levee and 22d St., will pe placed under ground.

The removal of overhead wires within the most thickly settled part of Boston is provided for by a recent act of the Massachusetts legislature. The work is to be done under the direction of a "Commissioner of Wires," to be appointed by the Mayor of Boston, and confirmed by the Board of Aldermen. There will be a board of appeal, consisting of the City Engineer, Superintendent of Streets and the chairman of the Board of Fire Commissioners. The intention of the act is to cause the removal prior to Jan. 1, 1900, of all overhead wires, and all poles within a prescribed section of the city, with the exception of long distance telephone wires, railway trolley wires or poles used exclusively for the support of such telephone or trolley wires or for supporting lamps. The salary of the commissioner is fixed at $5,000, or such other sum as the city shall provide, and he is to have the supervising of all wires within the city limits.

The Massachusetts state water meter inspector bill has been referred to the next legislature. This bill practically puts the water meters of the state in the hands of one man, and was strongly opposed by water-works officials.

The water power plant on the Canadian side of Niagara Falls has been commenced by the Canadian Niagara Falls Power Co. It will be approximately similar to that on the American side, and will have three turbines, with provision for adding three more.

A favorable report has been made by the committee on railways and canals on the bill authorizing an appropriation of $20,000 for preliminary surveys by the U. S. Engineer Corps on the most feasible route and the cost of construction of a ship canal to connect Lake Erie with the Ohio River. This sum is to be expended under the direction of the Secretary of War.

A meeting of persons interested in the improvement of the New York state canals was held at Albany June 15, and it was resolved to ask the Constitutional Convention to recommend the improvements of the Erie, Oswego and Champlain canals, the convention having power to present amendments to the constitution which would permit the issue of bonds for this purpose by the state.

The most serious railway accident of the week was the derailment of ten cars of a freight train near Batesville, Ind., on the Cleveland, Cincinnati, Chicago & St. Louis Ry., in which two tramps were killed and two more seriously injured.——A locomotive on the New York, Susquehanna & Western R. R., smashed a trolley street railway car at Paterson, N. J., on June 18, injuring a number of persons. The accident was caused by the failure of a gateman to close the crossing gates. The locomotive was drawing an express train at high speed.——On June 10 four persons were thrown from an electric car on the Macon and Indian Springs line, three miles from Macon, Ga. The car is said to have become uncontrollable on a curve.——A depressed joint in a street railway track at Detroit caused the overturning of a motor car June 10, injuring ten persons.

A derailment accident which occurred on the Chicago, Rock Island & Pacific Ry., at Round Pond, Okla., on June 6, was caused by the shifting of the track from the road-bed by a body of men, who first disconnected and then threw the track completely over for a distance of 955 ft. A stock train struck the track at the connected end running about 35 miles per hour, and replaced the track for a distance of 580 ft., when an angle bar broke, causing the rails to be displaced. Eight cars were badly smashed. A correspondent, in calling attention to this accident, notes that the replacing of the track by the engine, when running at about 35 miles per hour, for a distance of 580 ft. before leaving the track, is worthy of notice, and we do not call to mind a similar instance. The rails are 56 or 60 lbs. per yd., Union Steel Co.'s. make, 1888. The angle bars were 15 ins. long and broke at the rail joint on the right hand rail, the track being thrown to the left. The speed of the train was greatly reduced when the bar broke and it only moved 60 ft. further. The track was on an embankment of about 2 ft. in height having a descending grade of about 0.20% and near the foot of a 0.70% grade.

Explosions of fire damp in a coal mine at Karwin, Austrian Silesia, on June 14, caused a large number of deaths, estimated as high as 200.

The steamer "Plymouth," of the Fall River line, ran onto the rocks at the south end of Rose Island, just off Newport, on her trip from Fall River to New York, on the evening of June 18, and up to an early hour on June 20, was still fast aground. The accident is said to have been caused by the fog. The passengers were transferred to New York by rail. It is thought that the hull compartments of the steamer are broken.

The steamship "Ethiopia," of the Anchor Line, on her way from New York to Glasgow, struck an iceberg on June 6, while in a dense fog, and stove a hole in her bow. Temporary repairs were made and the vessel proceeded to Glasgow.

An Arctic expedition sailed from New York on June 20, on the "Portia," for St. Johns, N. F. From this point the party will take the steam whaler "Falcon," and its objective point will be Lieutenant Peary's headquarters on Inglefield Gulf, lat. 77° 43', which point it is hoped to reach on July 25. It is also planned to go to Ellesmere Land for the two Swedish naturalists who were wrecked in that vicinity in 1892.

In the investigation of the alleged Carnegie armor plate frauds, Lieutenant Ackerman, of the Bureau of Ordnance, U. S. N., stated that some plates which have been tested by the ballistic test were sent to the Washington Navy Yard to be sold for scrap steel. After the charge of fraud it was decided to take pieces from the plates adjacent to the place from which the specimen for physical test had been taken and test them in connection and comparison with the records of the physical test made by the government inspectors at the works. This was done and it was clearly shown that the plates had been re-treated. In the case of plate 619 the tensile strength of the plate was increased about 4,000 lbs. per sq. in., and its elastic limit made considerably higher. It was difficult to say just how the plate had been re-treated or how often. This plate was intended to earn a premium and was probably doctored for this purpose. It did not succeed in doing so, but passed well. He said that up to September last it was a rare thing for an inspector to visit the works at night. His visit to the works convinced him that something was wrong.

An amendment to the law designed to allow competition in designs for public buildings is said to have been agreed upon by a committee from the American Institute of Architects, and officials of the U. S. Treasury Department. The original law, it is claimed, has proved to be useless. The amendment provides for the appointment by the President, with the advice and consent of the Senate, of a Commission on Public Architecture, consisting of three architects of high standing and two officers of the Engineer Corps of the Army. For any building costing more than $100,000 the commission would select by ballot five architects to prepare competitive designs, and for any building costing less than $100,000 the commission would select an architect without competition. No architect would be selected in either of the above cases who had not had at least ten years' experience as an architect-in-chief. In the case of a competition, the successful competitor would receive travelling expenses and 5% of the cost of the building, and unsuccessful competitors would receive from $100 to $1,000, according to the labor involved.

Graphite paint, made by the Detroit Graphite Mfg. Co., is being used in repainting the large viaduct of the Detroit Union Railroad Depot and Station Co., over which the Wabash, the Flint & Pere Marquette and the Detroit, Lansing & Northern railways enter Detroit. The locomotives of the Michigan Central R. R. pass under the structure and the gases from their smokestacks are said to have nearly ruined ordinary paint which was applied a short time ago.

The vacuum brake is to be adopted in Uruguay, and the government has issued an order that all the rolling stock of the railway companies is to be fitted with the vacuum brake in such a way as will allow of the interchange of the rolling stock over the whole system of railways in Uruguay.

The tunnel for draining the Ontario mine is now 14,030 ft. long, and has been built under great difficulties due to falling material and water. It is timbered throughout, with a flat roof in safe ground, and an arched roof in bad material. For 600 ft. there is a material which bulges very badly, and large timbers have been broken and cracked like sticks. One part of the mine has already been tapped, relieving the pumps considerably, but the main level will not be tapped until about 900 ft. more is driven. Mr. Keetley is the engineer in charge of the work.

The New Jersey State Road Improvement Association has proposed that the meeting this summer at Asbury Park of the National Editorial Convention (many of whose members belong to road improvement societies, and all of whom will be interested in the subject) furnishes an unequaled opportunity for a conference of the various bodies and leading individuals concerned in the road movement throughout the United States, and a general interchange of views and experiences. If the suggestion is favorably received, the New Jersey Association recommends that the dates of July 5 and 6 be fixed upon and a general invitation be issued. The association has already had proposals for an exhibition of road-making machinery and of practical road construction, if a general road meeting is held. The secretary is E. G. Harrison, Asbury Park, N. J.

The methods of surveying public lands are involved in a proposed amendment to the pending sundry civil appropriation bill. The object of the amendment is to provide for surveys of public lands, being made by the U. S. Geological Survey. Should the method be found practicable it will result in the abolition of the contract system. The present sundry civil bill contemplates the appropriation of $200,000 for the making of topographic surveys under direction of the geological survey and $20,000 for the survey of private land claims, to be made under direction of the general land office.

Many of the electric railway accidents in Brooklyn, N. Y., are due to excessive speed of the cars, and Professor Plympton, of the Electric Subway Commission, has made investigation, showing that speeds of 12 to 16 miles per hour are attained in some streets where complaints have been made.

The 120 stamps of the San Miguel Consolidated Bear Creek mill, and the 40-stamp Gold King mill, at Telluride, Colo., are now being operated by electricity. The distance from the mouth of Bear Creek, where the connection was made with the electric power line of the San Miguel Consolidated to the Belmont mill is 19,000 to 20,000 ft. The distance from the mill to the generating station at Ames is nearly 14 miles.

Smoke prevention is being agitated in Milwaukee and an ordinance relating to it is pending before the city council.

The Willamette River at Portland, Ore., rose on June 7 to the 33-ft. mark, exceeding all previous records, flooding a large area of the city, stopping many street car lines, and interfering generally with business in the lower part of the city. Fire engines were placed on boats to fight at least one fire, and hundreds of boats were seen in the streets of the city.

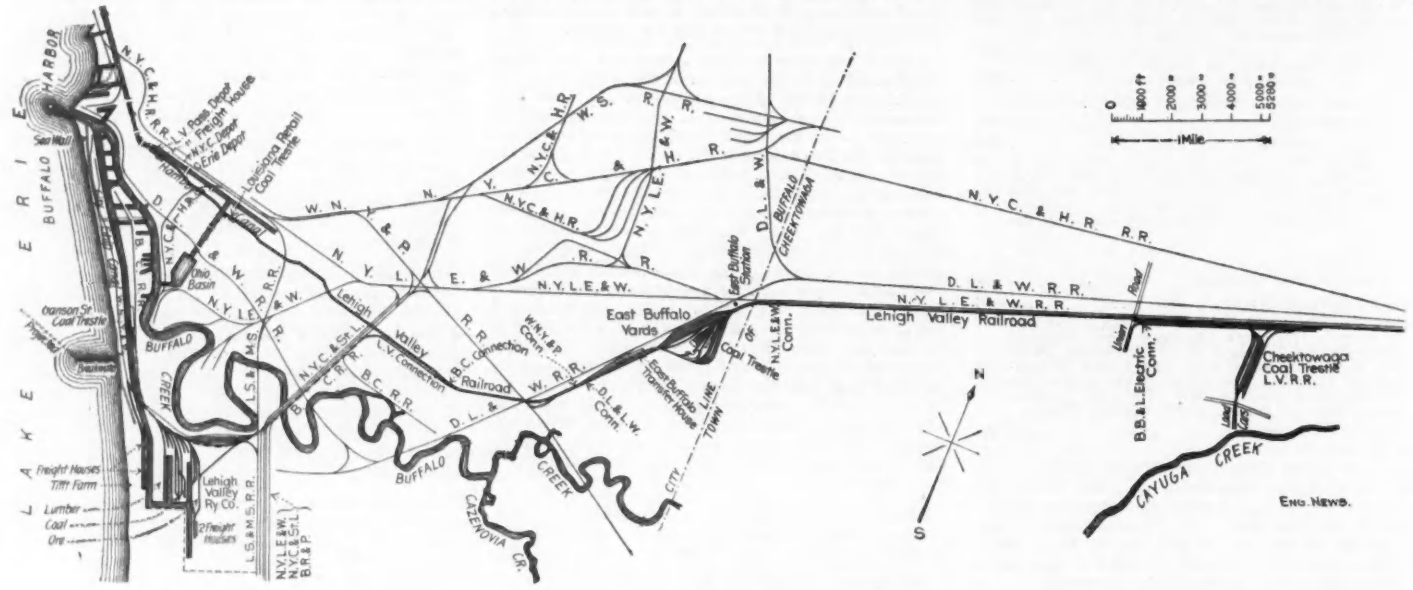
THE NEW TERMINALS OF THE LEHIGH VALLEY R. R. AT BUFFALO, N. Y.

The Lehigh Valley R. R. originally obtained entrance to Buffalo, N. Y., over the tracks of the New York, Lake Erie & Western R. R., but on Sept. 1, 1892, it opened its new line, commencing at Van Etten, N. Y., which gives it an independent line into Buffalo, where it has extensive terminal arrangements. This new line forms the Seneca & Buffalo Division, and was the route taken by the special train carrying members of the American Society of Civil Engineers from New York to Niagara Falls on June 19. It is double tracked throughout, laid with 80-lb. Sayre rails (modified to a very much slighter flare of head than the older Lehigh Valley R. R. standard 76-lb. rail) on ties 8 ft. 6 ins. long, laid in rock ballast. The depth from top of rail to roadbed is 24 ins. The width of roadbed is 28 ft., or 32 ft. over ditches in cuts, the ditches being of V section, 8 ins. deep. The tracks are 13 ft. c. to c., as shown in the cross section, Fig. 1. The line is 161.8 miles long, with a maximum grade of 0.4% and minimum curves of 4°. There are about 90 iron bridges on the line.

The route of the line through the city of Buffalo is shown in Fig. 2, which shows also the tracks of the numerous other railways centering in that busy city and lake port. The Lehigh Valley has connections with most of these roads. Approaching from the east, there is first the Cheektowaga coal stocking trestle on Cayuga Creek, then the East Buffalo yards, with coal trestle, round house, transfer house, etc.; then there is the connection with the Buffalo Creek Ry., by which access is obtained to the extensive freight and lumber yards, freight houses, and coal and ore docks on the Tifft Farm property on the lake, and the Ganson St. coal trestle on the city ship canal. The two largest freight houses here are 800 and 1,400 ft. long. The main passenger line continues on through the city to the terminal passenger and freight stations on Washington St., near the stations of the New York Central and Erie railways, but on the opposite side of the Hamburg Canal. On this line is the Louisiana retail coal trestle, convenient to the canal. The passenger station has a brick station building and a train shed 174 ft. long and 26 ft. wide, covering two tracks.

The line was built under the supervision of Mr. Paul S. King, M. Am. Soc. C. E., at that time Chief Engineer of the Lehigh Valley Ry. We are indebted to Mr. Charles E. Webster, the present chief engineer, for plans from which our cuts have been prepared. The construction work on the extension was let to various contractors; the freight houses and coal trestles were built by Buffalo and Philadelphia contractors.

The East Buffalo yard is a good example of modern practice, and its plan is shown in Fig. 3. It is of triangular form, and its length from Weiss St. to New South Ogden St. is 3,000 ft., and its greatest width about 1,500 ft. It has an area of about 55 acres. The two main tracks pass across the lower side of the yard, with 15 freight tracks on the south and 16 on the north. The tracks are 12 ft. apart c. to c. These will accommodate about 1,000 cars. From the west end of the yard are turnouts to a set of nine coopering tracks for road repairs to cars and also to a double-track coal trestle and coal tracks. The central portion of the yard is occupied by a machine shop, a round house with 31 stalls, water tank and water crane, storehouse, office building, boiler and engine rooms (with coal trestle), carpenter shop, etc., while toward the east end are the car repair shop, blacksmith shop, paint shop, etc. There is a 4-in. water pipe to the car repair shop and an 8-in. pipe to the roundhouse and machine shop, with 6 and 3-in. pipes through the shops. The round house and yards drain towards the turntable pit, from which a 20-in. tile drain leads to a masonry drain 24 × 36 ins. The main entrance to the repair and coal tracks is from the west end, but connections are also provided from the east end.



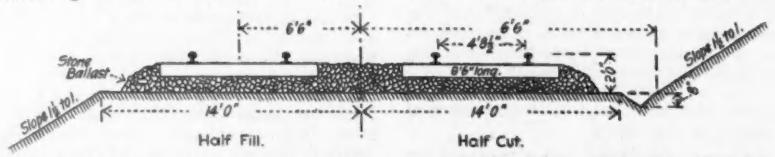
PLAN OF BUFFALO TERMINALS; LEHIGH VALLEY RY.

IMPACT TESTS OF M. C. B. COUPLERS.

The committee appointed by the Master Car Builders' Association in 1891 to investigate and report upon automatic coupler standards and limits presented the final report upon the result of its three years' labor at the annual convention of the association, held at Saratoga, N. Y., last week. Two previous reports have been presented; the first in 1892, outlining a series of tests to be made on the various makes of couplers, and the second, in 1893, describing the results of these tests as far as they had been carried out at that time This last report was published in our issue of June 22, 1893, and, as there stated, the committee was continued to further prosecute the tests outlined in its first report. After considering the subject carefully the committee decided to make three shock tests, approximating as closely as practicable the shocks encountered in actual service, as its work for 1894. The following is an abstract of the principal features of these tests, as given in the report:

The three tests decided upon were: (1) A drop test of the coupler, resting on a draft spring with a slight lateral play given to the shank. This test, by transmitting the blow to the solid foundation through the draft spring and through the horn, was considered to represent very nearly the service required of couplers in resisting concussion. (2) Guard arm tests with the couplers supported as in the first test, to determine the relative strength of the guard arm and the shank immediately back of the head, and (3) A jerk test, representing the strains which the coupler would be called upon to resist in starting heavy trains or when trains passed over points of change in grade. Five couplers of each make were tested, two each by the drop and jerk tests and one by the guard arm tests. The conditions prescribed were: (1) In the drop test the coupler should withstand three blows of a 1,540 lb. hammer, falling from a height of 5 ft. and three from a height of 10 ft., and should then be tested to destruction by blows of the hammer falling 15 ft., the hammer to strike directly upon the knuckle; (2) in the guard arm tests the coupler should withstand three blows of the hammer, falling 3 ft. and then be destroyed by blows falling 5 ft., the blow to strike fairly upon the guard arm, and (3) in the jerk test two couplers inverted and suspended from pedestals by tail bolts, yokes and draft springs, should withstand three blows from a height of 5 ft. and three blows from a height of 10 ft., and then be destroyed by blows from a height of 15 ft., the hammer to strike on an equalizer bar connecting the two couplers. This equalizing bar was so shaped at the ends as to bring a direct pull upon the knuckles of the pair of couplers under test with the least possible spreading action.

The following methods were observed in procuring the data. In the striking test, the weight was allowed to rest on the knuckle while the original



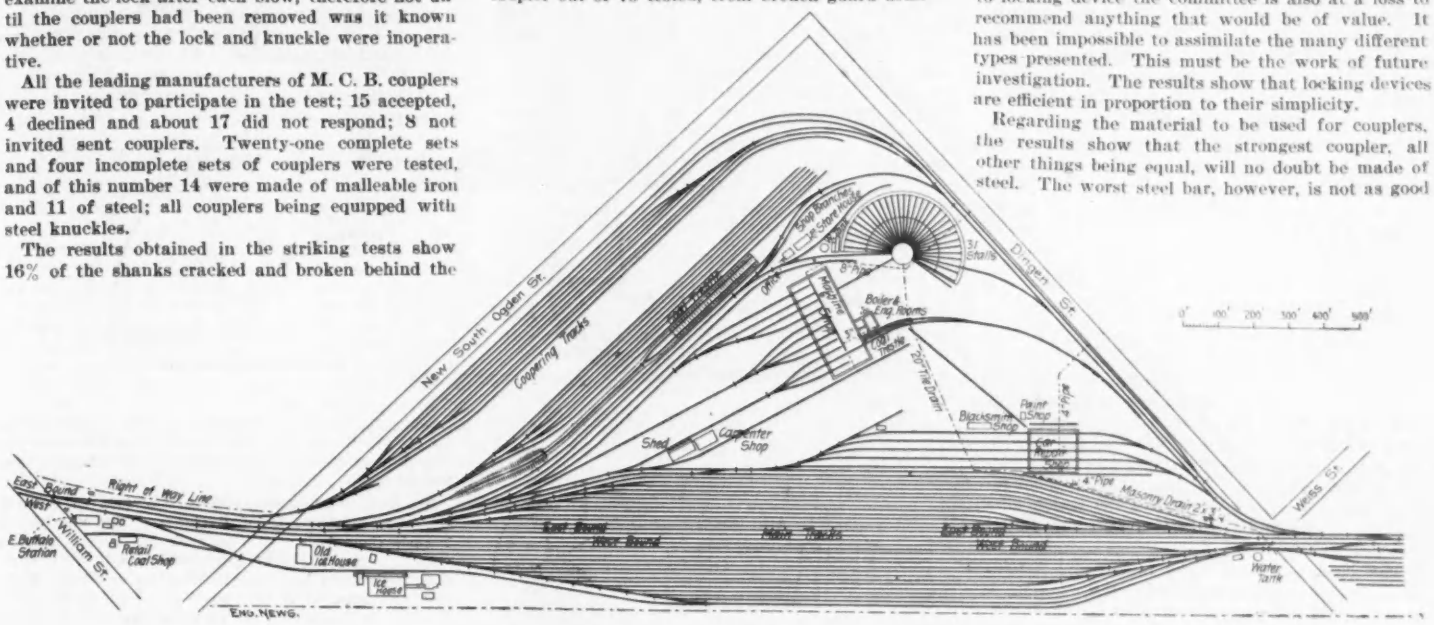
CROSS-SECTION OF ROADBED ON BUFFALO EXTENSION; LEHIGH VALLEY RY.

and all other knuckle openings were measured. The coupler was carefully examined and measured after each blow and its condition noted. If it failed from the knuckle being inoperative, or the opening closed down ⅜ in., or from any part being fractured or bent so as to prevent proper manipulation, it was considered unfit for further test. If the knuckle had gone below the limit of ⅜ in. with the weight upon it, the weight was raised and the knuckle opened so far as the lock would permit and the opening measured, which decided whether or not it was actually down to the limit; hence the two measurements found for one opening in the table under striking test. In the guard arm test the con-

dition of coupler was carefully noted after each blow and the requirements for its rejection were the same as for the striking test, except as far as the knuckle was concerned. For the jerk test the weight of the equalizer bar was considered sufficient to rest on the knuckles while the measurements were taken. The couplers of this test were rejected under the same conditions as those governing the striking test. It was not feasible to examine the lock after each blow, therefore not until the couplers had been removed was it known whether or not the lock and knuckle were inoperative.

All the leading manufacturers of M. C. B. couplers were invited to participate in the test; 15 accepted, 4 declined and about 17 did not respond; 8 not invited sent couplers. Twenty-one complete sets and four incomplete sets of couplers were tested, and of this number 14 were made of malleable iron and 11 of steel; all couplers being equipped with steel knuckles.

The results obtained in the striking tests show 16% of the shanks cracked and broken behind the head, 26% cracked and broken in the head, and 40% of the knuckles broken. In the jerk tests the figures show 9.5% of the couplers broken in the heads and 26% of the knuckles broken. The remaining couplers were thrown out because of distortion beyond the limits of the test by the combined failure of pivot pins, knuckles and locks. The results of the striking and jerk tests, considered together, show that out of 92 couplers 22.8% of the knuckles were broken or cracked, and 30.4% of the couplers broken either in the head or shank, and 52% failed on account of distortion. These last figures go to show that the pivot pins are generally weak, allowing the knuckles to close before any damage is done. Of the knuckle failures 70% are in the tongue, 14% in one or both lugs, and 14% in the pin hole. In the guard arm tests, 68% show broken shanks, 27% broken guard arms and 18% broken locks. As will be seen from the figures, some couplers show two or more failures. In an additional guard arm test to destruction, 86% failed from broken shanks and only 2.6%, or one coupler out of 75 tested, from broken guard arm.



PLAN OF EAST BUFFALO YARD; LEHIGH VALLEY RY.

The results of the test conflict with the results shown in service. In service there is a preponderance of guard arm failures, while the tests show a preponderance of shank failures. The probable explanation is that direct blows concentrate the shock on the opposite side of the shank, whereas a glancing blow or one from a broken link and pin coupler wedges off and breaks the guard arm alone. This point seems to be recognized by coupler manufacturers, who are strengthening the guard arm.

In conclusion, the report calls attention to the necessity of revising the dimensions of the shank immediately behind the head. While larger fillets would accomplish good results, at the same time a more satisfactory design would be the widening of the shank for a short distance, together with the introduction of larger fillets. Attention is called to the indifference displayed toward the M. C. B. contour lines. Out of 114 couplers presented, representing 25 different kinds, but 20 couplers fully complied with the M. C. B. limit gages. In regard to locking device the committee is also at a loss to recommend anything that would be of value. It has been impossible to assimilate the many different types presented. This must be the work of future investigation. The results show that locking devices are efficient in proportion to their simplicity.

Regarding the material to be used for couplers, the results show that the strongest coupler, all other things being equal, will no doubt be made of steel. The worst steel bar, however, is not as good as the best malleable iron bar, although the best steel bar is superior to the best malleable iron bar, and the poorest steel bar is better than the poorest bar made of malleable iron. It does not follow, however, that the use of malleable iron is to be condemned, for the reason that the committee does not believe that strength alone is the all-important item. Few structures, involving expenditure of money, are designed to do more than is required of them with the proper safety factor. A coupler of steel or one of malleable iron may be made so heavy and so large as to be practically indestructible, and at the same time it would be neither

TABLE SHOWING SUMMARY OF RESULTS OF M. C. B. COUPLER TESTS MADE IN 1894 BY A COMMITTEE OF THE MASTER CAR BUILDERS' ASSOCIATION.

Name of coupler.	Material in draw-bar.	Average weights. Coupler, complete, lbs.	Average weights. Knuckle, lbs.	Striking test. Coupler No. 1. No. of blows.	Coupler No. 1. Broken in.	Coupler No. 1. Cracked in.	Coupler No. 2. No. of blows.	Coupler No. 2. Broken in.	Coupler No. 2. Cracked in.	Guard arm test. Coupler No. 3. Average No. of blows.	Coupler No. 3. No. of blows.	Coupler No. 3. Broken in.	Coupler No. 3. Cracked in.	Jerk test. Coupler No. 4. No. of blows.	Coupler No. 4. Broken in.	Coupler No. 4. Cracked in.	Coupler No. 5. Broken in.	Coupler No. 5. Cracked in.
American	S.	227.6	51.6	5	.....	.....	4	.....	Knuckle.	4½	16	Shank.	.....	4	.....	.....	.....	.....
Buckeye	M. I.	220.2	59.8	5	.....	G. Arm.	7	Knuckle.	.....	6	2	Lock inoperative.	.....	4	Knuckle.	.....	Knuckle.	.....
California	S.	211.8	33.5	4	Knuckle inoperative.	.....	4	.....	.....	4	18	Shank bent.	.....	5	.....	.....	.....	.....
Chicago	S.	222.2	49.8	8	.....	Knuckle.	9	Knuckle.	.....	8½	18	G. arm and lock inop.	Head.	5	.....	.....	.....	.....
Dickey	S.	212.7	44.5	5	.....	.....	5	.....	.....	5	9	Shank.	.....	4	.....	.....	.....	.....
Eureka	S.	238.5	48.0	6	Knuckle.	.....	3	Knuckle.	.....	4½	....	.....	.....	.....	.....	.....	.....	.....
Excelsior	S.	204.7	50.9	7	.....	.....	7	.....	Knuckle.	7	9	Lock inoperative.	Shank and G. arm.	6	.....	.....	.....	.....
Gould	M. I.	213.6	37.5	4	Knuckle inoperative.	.....	7	Knuckle.	.....	5½	4	Shank.	.....	5	.....	.....	.....	.....
Improved Standard	M. I.	215.7	66.1	8	Lock inoperative.	Head.	7	Lock inoperative.	Head.	7½	5	Shank.	.....	5	Lock inoperative.	.....	Lock inoperative.	.....
Johnston	M. I.	171.6	36.0	6	Head and shank.	.....	5	Knuckle and shank.	G. arm and head.	5½	2	G. arm.	.....	1	.....	.....	Knuckle.	.....
Kansas City	S.	215.6	61.3	6	Head.	.....	6	Knuckle.	.....	6	9	Shank.	.....	3	.....	.....	.....	.....
Klinger	S.	280.25	68.0	5	.....	.....	5	.....	.....	5	....	.....	.....	.....	.....	.....	.....	.....
Lathem	M. I.	232.5	37.4	4	Knuckle.	.....	4	.....	Knuckle.	4	4	G. arm.	.....	4	Head.	.....	Head.	.....
Lathem A	M. I.	233.6	37.9	1	Lock inoperative.	Knuckle.	2	.....	Knuckle.	1½	5	Shank.	.....	4	.....	.....	Knuckle.	.....
Little Giant Buckeye	M. I.	195.8	49 4	7	Head.	Knuckle.	7	Knuckle inoperative.	Head.	7	3	Lock inoperative.	.....	9	Pin and lock.	Head.	.....	Head.
Park	M. I.	168.75	38.5	3	Knuckle.	.....	5	Head.	.....	4	....	.....	.....	.....	.....	.....	.....	.....
Pooley	M. I.	205.4	39.1	4	.....	.....	4	Knuckle.	.....	4	6	G. arm.	.....	5	.....	.....	.....	.....
S. H. & H	S.	215.6	50.4	6	.....	Head.	6	.....	Head and shank.	6	5	Shank.	.....	4	Knuckle.	.....	Knuckle.	.....
Smillie	M. I.	198.4	44.6	5	.....	.....	6	.....	.....	5½	2	Shank.	.....	3	Knuckle.	.....	.....	.....
St. Louis	S.	212.5	58.6	6	.....	.....	6	.....	.....	6	11	Shank.	.....	6	Lock inoperative.	.....	Lock inoperative.	.....
Tower	M. I.	218.4	47.9	7	Shank and thrower.	Head.	6	Shank and thrower.	Head.	6½	4	Shank.	.....	4	Knuckle.	.....	.....	.....
Trojan	M. I.	225.5	53.5	8	.....	Shank.	8	.....	Shank and head.	8	7	G. arm.	.....	5	Knuckle.	.....	.....	.....
Van Dorston	M. I.	231.6	53.2	4	Knuckle inoperative.	Knuckle.	6	Knuckle.	.....	5	4	Shank.	.....	2	Knuckle.	.....	Knuckle.	.....
Van Dorston A	M. I.	224.0	52.5	2	Pin.	Knuckle.	3	Knuckle.	.....	2½	4	Shank.	.....	.....	.....	.....	.....	.....
Williams	S.	195.7	41.5	7	.....	Knuckle.	7	Shank.	.....	7	7	Shank.	.....	5	.....	.....	.....	.....

NOTE.—There were 46 bent pivot pins not shown in this table, and 48 couplers went below the limit.

cheap in first cost nor satisfactory to use. Further developments would seem to be in the line of making a coupler as light as possible, and sufficiently strong to meet the strains to which it is subjected, of as cheap material as is consistent with the above; and the coupler which will have the highest commercial value will be the one which combines the elements "minimum weight," "minimum first cost," "the greatest average strength," and "the most perfect yet simple action." In addition to this must be considered also the cost of renewals of couplers which have failed in service.

SUBMERGED WATER-WORKS INTAKE AT BURLINGTON, VT.

The new water-works intake now being built by the city of Burlington, Vt., consists of 2¼ miles of 24-in. cast-iron pipe, laid with a Falcon ball joint every six lengths, and terminating with a submerged crib and strainer in 23 ft. of water. A view of the scow and derricks used in laying the pipe is shown by Fig. 1, and the details of the submerged strainer by Fig. 2

Water-works were built by the city in 1867, taking their supply from a point near the dock line of the harbor of Burlington Bay, Lake Champlain. With the growth of the city and the increasing pollution of the water of the bay by sewage, street and dock drainage there has been a growing demand for an extension of the intake into the lake to a point beyond all danger of possible contamination. This demand has been emphasized by typhoid fever and other sickness attributed to the water supply, as discussed editorially in our issue of July 28, 1892.

The shore end of the new intake will terminate in a pump-well about 16-ft. from the pumping station and 80 ft. from the face of the dock. The water along the line of the pipe increases gradually in depth from 12 ft. at the dock line to 55 ft., some half a mile or so out, from which the depth is about 55 ft. until Appletree Reef is reached, where the pipe terminates in 23 ft. of water. For the first 2,000 ft. the lake bottom is of sand, mixed with clay, beyond which the bottom consists of from 6 to 8 ft. of mud, resting on sand.

Six lengths of pipe and one Falcon ball joint are put together on shore, making a section of 75 ft., each length and each ball joint weighing one ton. Each section so joined is tested on shore before laying and every 1,000 ft. is tested after being laid. It takes one hour to make each connection under water.

In laying the pipe a scow, fitted with two derricks on each side, as shown in Fig. 1, from a photograph, is used. The scow carries two 75-ft. lengths of pipe, one on each side, from the shore to the point of laying, being moved by a propeller and side wheels.

The details of the submerged crib and proposed intake strainer are shown by Fig. 2. It is expected

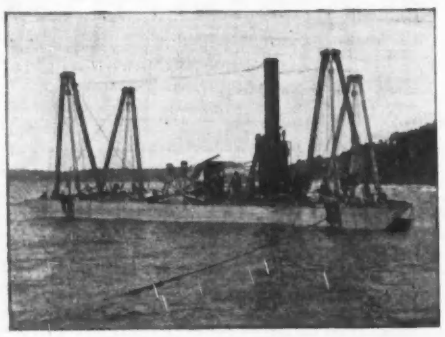
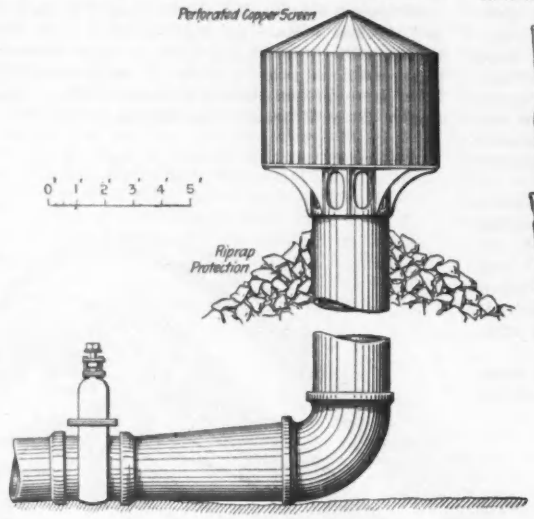


Fig. 1. View of Scow and Derricks for Laying Submerged Water-Works Intake at Burlington, Vt.; Joseph G. Falcon, Contractor.

that the strainer will be of ½-in. copper, perforated at the sides and top and at the bottom of the overhanging part. In case of stoppage of the strainer by ice the relief ports will rise from the iron frame supporting the strainer, allowing the free admission of water, as may be seen by referring to Fig. 2.

Mr. Joseph G. Falcon, of Evanston, Ill., but at present located at Burlington, Vt., is the contractor for this work and we are indebted to him for the information given. The pump-well has been completed and on June 14 pipe had been laid from it through the station yard and 4,000 ft. into the lake.



INTAKE STRAINER IN LAKE CHAMPLAIN AT BURLINGTON, VT.

By July 1 it is expected that 7,000 ft. will have been laid, and a tee and temporary strainer placed in 50 ft. of water.

PERSONALS.

Mr. Lee Shaffer has been appointed Superintendent of Water Works at Manhattan, Kan.

Mr. Charles W. Mead, formerly General Superintendent of the Northern Pacific R. R., died at Los Angeles, Cal., June 14.

Mr. F. W. Dalrymple has resigned his position as City Engineer of Bradford, Pa., and has been appointed City Engineer of Hornellsville, N. Y.

Mr. Herschel Roberts, of Cobleskill, N. Y., has been appointed Deputy State Engineer, vice Mr. F. R. Beeker, resigned on account of ill health.

Mr. W. J. Thomas, Superintendent of the Tracey City Branch of the Nashville, Chattanooga & St. Louis Ry., died at Tracey City, Tenn., June 10, at the age of 67.

Mr. John Tobin has been appointed Chief Engineer of the International & Great Southern Ry., which is about to be built from San Antonio to Brownsville, Tex.

Mr. F. W. Denton has severed his connection with the Michigan Mining School, where he has had charge of the Mining and Civil Engineering departments.

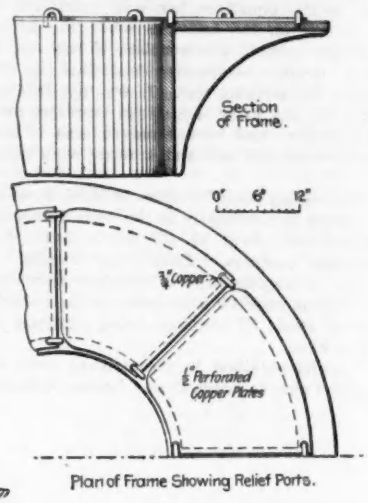
Mr. A. W. Cooke, formerly City Engineer of Chicago, has been appointed Chief Engineer and Superintendent of the Sewerage Department of Chicago, vice O. A. Cheney, deceased.

Mr. Michael Dolan, who died at Lexington, Ky., June 15, at the age of 70, was one of the contractors on the Cincinnati Southern, the Louisville Southern and the Kentucky Union railways.

Mr. Joseph M. Wilson, C. E., of Philadelphia, a graduate of the class of 1858 of the Rensselaer Polytechnic Institute, delivered the address before the graduating class of that institution at Troy, on June 13.

Mr. Peter C. Asserson, Civil Engineer, U. S. N., of the Yards and Dock Department, at the Brooklyn Navy Yard, has been detached and ordered to duty at the Puget Sound Naval Station, Sidney, Wash., to relieve Mr. Ulysses S. G. White, who has been on duty there as engineer since the station was established in 1892.

Mr. Duncan McIntyre, a well-known Canadian railway man, died at his home in Montreal June 12. After a very successful business career he retired, in 1880, with an ample fortune and became a director of the Canada Central Ry. Co. When the contract was secured for the construction of the Canada Central extension he took a part interest in it, and as the result of a succession of transactions and changes he became



Plan of Frame Showing Relief Ports.

president of the road in 1881, and was reported to be its virtual owner. On June 9, 1881, the Canadian Pacific Ry. acquired all the rights of the Canada Central Ry.

Mr. Wm. Barclay Parsons, M. Am. Soc. C. E., was on June 18 elected Chief Engineer of the new Rapid Transit Commission of New York city. Mr. Parsons was Principal Assistant Engineer of the old Commission, both while Mr. Wm. E. Worthen was Chief Engineer and later while that office was held by Mr. John Bogart. In the designs for an underground rapid transit system, submitted to the Commission by its engineer in October, 1891, Mr. Parsons presented plans for a two-story four-track system and included the permanent disposal of all pipes and underground wires in the street. Mr. Parsons' plans were published in our issue of Oct. 24, 1891.

NEW PUBLICATIONS.

REPORT OF THE GERMAN-AMERICAN TECHNICAL ASSOCIATION. Secretary, A. Merick, Pittsburg, Pa. 8vo; pp. 62.

This report for 1892-93 shows a total of 608 members in 12 local associations, the membership including engineers, architects, electricians, chemists, etc.

ASPHALT PAVING: Reports of Experts Appointed by Special Sub-Committees of the Citizen's Municipal Association, of Philadelphia, and of the Trades League, of Philadelphia, to Investigate Asphaltic Materials Available for Street Pavements in Philadelphia. Published by the above associations. T. B. M. Addis, agent Citizen's Municipal Association. 8vo.; paper; pp. 29.

A full abstract of this report is given elsewhere in this issue.

COUNTRY ROADS.—Edited and Published by Isaac B. Potter, Potter Building, New York. 12mo; pp. 64; illustrated; 10 cents.

This interesting and useful little book forms the first number of "Potter's Good Road Library" series, and is full of practical arguments on the advantages of good country roads, and practical information as to the construction of these roads, their cross section and drainage, the design of culverts and drains, and the use of road machines and road rollers, and there is also a chapter on bridges. The book is well written and profusely illustrated, and in view of the steady growth of the movement in favor of good roads it should have, and probably will have, a large sale.

ROADMASTERS' ASSOCIATION OF AMERICA: Proceedings of the Eleventh Annual Convention, held in Chicago, Ill., Sept. 12, 13 and 14, 1893. Secretary, W. W. Sharpe, Waycross, Ga. 8vo; pp. 280.

This book contains in full the business proceedings of the convention, and the discussions of the various reports on track work, which were given at some length in our issue of Sept. 21, 1893. These verbatim reports of such discussions are of great value and importance, in that they place on record the views on both sides of the question and also place on record the various opinions and methods of practice which are eventually crystallized in the several committee reports as amended and adopted by the association. One report of which the discussion will probably be read with considerable interest is that relating to the position of the roadmasters toward the Brotherhood of Section Foremen, one of the most recent of the numerous secret organizations which railway officers have to consider (or may have to consider) in questions relating to

their dealings with the employes. Some of the members were inclined to antagonize the brotherhood, but it was pointed out that such a course would be extremely unwise, especially as the brotherhood is already established, thus leading to a certain ill feeling between the roadmasters and their foremen. Another important report is that on "Economy in Track Work," the principles of which economy are not as fully recognized as they should be by the higher officials and executive officers, as pointed out in our issue of June 15, 1893. At the end of the book are given five well-written and practical papers on "How to Maintain the Best Track at the Least Cost," written in competition for a prize

SOCIETY PROCEEDINGS.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—The twenty-seventh annual convention of the association was opened at Convention Hall, Saratoga, N. Y., June 18, President John Hickey presiding. It was announced that Hon. Chauncey Depew, who was to have delivered the opening address, was unable to do so on account of illness, and Judge Lester, of Saratoga, spoke a few words of welcome instead. The president then read his annual address. Among other points, especial attention was called to the necessity of the more economical operation of locomotives. The chief item of expense was fuel, and it behooved all to pay the utmost attention to this item. A great advance had been made in fuel economy by the compound locomotive, and its increased adoption was a question which should be considered by all. In closing, President Hickey referred to the amalgamation of the Master Car Builders' and Master Mechanics' associations, whose usefulness he thought would be increased by such a move, with a great saving in time and expense to the members who now belonged to both associations.

After some routine business the report of the secretary was read. This showed the present membership of the association to be 587, of which 552 were active members, 17 associate members and 18 honorary members. This was an increase of 55 active members and 3 associate members during the year. The total amount of money collected from all sources during the year was $3,192.50. In closing his report, the secretary stated that the attempt to secure $5,000 to defray the expenses of making locomotive tests at Purdue University, by subscriptions from railway companies, had failed. Most of the roads expressed themselves in hearty sympathy, but in view of the extreme hard times, could not see their way clear to make an expenditure for such a purpose at the present time. A few companies expressed their willingness to subscribe and all stated that they would gladly do so as soon as earnings improved.

The report of the treasurer showed: Cash on hand at the beginning of the year, $154.28; money received from the secretary, $3,192.50; total receipts, $3,346.78; expenditures, $2,985.58, leaving a balance on hand of $361.20. A committee, consisting of L. R. Pomeroy, Alva Mitchell and W. H. Lewis, was elected to audit the year's accounts.

Under the head of unfinished business it was voted that hereafter the secretary should have the committee reports printed, and sent to the members as soon as received. A motion was then presented by Mr. Henderson to the effect that the association should formulate rules providing for the use of a decimal gage in ordering sheet metals. It was voted that the question be referred to the committee on subjects for the coming year.

The following were elected honorary members on vote of the convention: Messrs. Charles Graham, A. W. Sullivan, B. R. Harding and W. H. Selby. Mr. W. S. Squire was elected an associate member. No further business being on hand, the reading of the reports of committees was taken up. The first report was on the "Cracking of Back Tube Sheets," which was read by the chairman of the committee, Mr. T. B. Purves.

Cracking of Back Tube Sheets.

The nearly universal testimony of the answers to the committee's letter of inquiry was that: (1) Radial stayed boilers carrying high pressure were more subject to cracked tube sheets than any other kind; (2) that the causes were two-fold—first, too rigid staying of the crown sheet adjacent to the flue sheet and flange thereof; and, second, placing flue holes too close to flanges. Possibly some of the difficulty was chargeable to the high steam pressures carried. To remedy the difficulty the testimony seemed to be that such provision should be made for staying the front end of the crown sheet as would give the requisite support, coupled with sufficient flexibility to allow for the force developed from expansion and contraction to be concentrated at the joint of the back tube sheet with the crown sheet. The report stated that the experience of Canadian roads on this point was particularly valuable, as they had been using radial stays a number of years. They claimed that crown bars gave better satisfaction than sling stays for the first two rows of stays at the front end of the crown sheet. Other roads had stated, however, that in building new boilers they would use crown bars, but that in repairing old boilers sling stays could be more cheaply applied and seemed to answer every purpose.

The reading of the report was followed by a very free discussion regarding the liability of radial stayed boilers to crack in the back tube sheet as compared with other types.

In opening the discussion Mr. A. E. Mitchell (N. Y., L. E. & Wn.) stated that although his road had a large number of wagon-top boilers in use they had experienced but very few cases of cracked tube sheets except where bad water was used. He found that the sheets cracked between the flue hole and flange, and in building boilers he had omitted the top flues and moved the stays back a little. With boilers constructed in this way he had experienced no trouble so far.

Mr. S. M. Vauclain (Baldwin Locomotive Works) said he thought the cause of cracked back tube sheets was due to other things than the manner of staying. The trouble was often bad water. Often also trouble was caused by the water space between the tubes being too small. The contraction and expansion of the tubes caused the sheet to crack and not the radial stays. His cure was to remove some of the tubes. Better results would be obtained if the water space was increased to 9-16 or ¾ in., or better still, to ½ in., both in the life of the boiler and in the fuel consumed. He had found this to be true where the heating surface of a boiler had been cut down 20%. Mr. J. W. McConnell (Union Pacific) stated that with bad water his experience had been that radial stayed boilers would crack both in the flue sheets and door sheets. He used water containing 91 grains of solid matter to the gallon, and of this 82 grains were soda, and had found that the only way to overcome cracked sheets was to use crown bars in place of radial stays.

Mr. A. J. Cromwell (B. & O.) stated that he had had some experience with radial stays principally on freight locomotives, and had found that the flanges of the flue sheets leaked. On examination, he would find the crown to be sprung at the head, which gave the impression that the stays kept the sheet from going up, and as the sheet was forced up between the stay bolt and flue head, it was bent at that point and caused to leak. He never had such trouble with Wootten engines, or engines with crown bars. With the crown bars the sheet would rarely come down, but the bolts would have to be renewed.

Mr. Setchell (Pittsburg Locomotive Works) stated that he was an advocate of the radial stay boiler. He thought it an admitted fact that that type of boiler gave better water circulation, and was therefore a better steaming boiler than a boiler with crown bars, which frequently got filled with scale on top of the crown, the most effective heating surface in boiler, and required to be cleaned out at considerable expense every little while. If that was the case, it seemed that the rational thing to do was to set about for a remedy, to inquire into the cause of this trouble in radial stay boilers. In firing up an engine, the first cause that operated against the flue sheet was the fact that all the flame had a tendency all in that direction. Otherwise, there was no reason why the side sheets should not expand just as well as the flue sheet. Again, the flue sheet was cut up. There was not one-quarter of the water space in the flue sheet that there was in the side sheets. It played an important part in the destruction of the flue sheet whether you had a large water space between the flues or a space so narrow that the flame drove the water from the flues. There must be water there to make steam and to protect the flues, and water was very easily driven from between the flues when the space was narrow. It had been demonstrated that when a large portion of the flues was removed, up to 20% or 30%, as good results were obtained from the boiler as with the large number of flues and small space.

Mr. Hill stated that he had never heard anybody complain of the flat crown sheet cracking at the tube sheet connections. In ten years he had had hundreds of engines with flat crown sheet with flues close together, and never had any trouble whatever with these tube sheets or with the crown sheets. In one winter he had 39 engines burned, and never had a crown sheet that could not be put back. Some of the members had spoken about the box expanding more than the shell. Most of the old members who remember the trouble experienced ten years ago with cracked fire boxes would recall that they always cracked not far up, in nine cases out of ten, and when they did crack, they pulled apart 1-16 in. He believed the expansion in Mr. Cromwell's engines was simply under the flue sheet.

Mr. Wells stated that he thought the radial stay boiler was as safe as the crown-bar boiler, provided the crown was protected from going down from low water. When it became heated, as it sometimes did, if it was not provided with a hood, the crown sheet would come down, and when it started down it would very likely take the whole firebox with it. He had occasion to examine a radial stay boiler a few years ago, with the staybolts broken from the side sheets to the number of 15 or 16 at one place. The side sheet gave way and came over from the right-hand side to the left-hand side, and it tore off the heads of the crown bolts in two rows; but from the third row over to the other side they were perfectly secure, and the result was the sheet's failure did not destroy the firebox. It tore off all the staples and bolts on the side, and yet the crown bolts held the crown up, except two rows, where the bending of the sheet pulled the heads off. If that had been a crown-bar boiler, the crown sheet, as a matter of course, would have gone down.

The Belpaire boiler was a strong boiler. He had commenced using it some 15 years ago. So far as he knew, there was never any trouble experienced in the cracking of the flue sheet, or in the crown sheet coming down. He thought the Belpaire boiler and radial stay boiler stronger and more secure than the boiler supported by crown bars. If there was a difficulty in the flue sheet cracking at the flange, that could be overcome by a mechanical arrangement, and the difficulties that were mentioned of the flue sheet cracking between the tubes were just what has occurred ever since locomotives have been used. When wood was used as a fuel there was more trouble with the tube sheets cracking than now. It was a common thing to find cracks between the tube holes, particularly between the upper corners, and to make them last a while the common practice was to drill a hole and screw a plug in, and in that way they would run for some time. The main difficulty came from the repeated rolling of the tubes. The metal was stretched and the flange of the tube was finally crowded or raised from its original position. The crown sheet should be allowed to go with it. To do that, it was only necessary to make one or two rows of sling stays, or anything that would allow the crown to go up, and the difficulty would be obviated.

Mr. McIntosh considered that the discussion had demonstrated that considerable expansion took place in the back tube sheet. He attributed it to the fact that the circulation was slow in starting, as the fire was built; with the result of the heating of the back tube sheet very much more than any other portion of the boiler, and in consequence causing it to expand upward. There was no doubt that by putting sling stays there it would assist in overcoming the difficulty. Keeping the boilers hot and filling them with hot water would also help in that direction. As to holding the radial stay sheet in place, he thought that radial stays placed a proper distance apart, and secured with a good sized hood on the under side, must sustain the crown sheet equally as well as where they were attached to crown bars. In many cases the water spaces between the tubes were too narrow.

Tuesday's Session.

At the Tuesday morning session the discussion of the report of the committee on Cracking of Back Tube Sheets, which had been interrupted by adjournment on Monday, was continued. At the request of President John Hickey, Mr. Jacob Johann was called upon to open the discussion.

Mr. Johann stated that he had given the matter of radial stay boilers very considerable attention, and had arrived at the conclusion that in practice the radial stay boiler was decidedly preferable to crown-bar boilers. As the older members would recall, he had in 1879 presented drawings of a radial stay boiler. That particular boiler was put on the road in service in October, 1879, and in May, 1885, the firebox and radial stays, and, in fact, every part of the boiler, were in perfect condition. The boiler was still in operation and about three months ago was still in good order. About a year ago three of the stay bolts were drilled out, and found to be perfectly sound. The further he went into the radial stay system, the more he was convinced it was in the right direction.

Mr. William Smith stated that he had a few radial stay boilers, but they had not been in service long enough to develop any defects. He wished to say that he had seen all the defects in crown-bar boilers that had been spoken of in the radial stay boiler, with the exception of the cracking of the flange in the flue sheet at the top. He saw one good reason why sling stays should be put in the front and not in the back. In the back, the back sheet and back head are connected together, and when the water commenced to warm up, expansion set in in both of them, whereas in the front flue sheet there was nothing to convey the heat to the forward end of the wagon top, and expansion did not set in there until after the steam commenced to rise, consequently, something had to go, as the firebox expanded with the heat before the forward end of the wagon top. There was one thing that should be done in the radial stay boilers, and that was that swash plates be put in to stop the wash of the water forward. He would recommend putting a crown bar or swash plate in front

of the firebox; a couple of crown-bars in front would probably serve the purpose.

On motion of Mr. S. M. Vauclain, the discussion was closed, and the report on Oiling Devices for Long Runs was read by the chairman of the committee, Mr. J. Davis Barnett.

Oiling Devices for Long Runs.

The report was made up largely of descriptions of the oiling devices used by a number of American and British railways, which were accompanied by drawings. Briefly summarized, the points brought out were that special oiling devices were much more extensively used abroad than in this country. The characteristic broadly marking foreign practice was the use of oil reservoirs at high levels, which could, if necessary, be filled while the engine was running. They were of brass, square in plan, with hinged top lid, and were internally divided into sections corresponding to the number of small tail pipes leading from them, in the case of axle boxes, usually one to the journal and one to each jaw's face. Worsted syphon feeders were common, also horizontal plug cocks for each pipe, to prevent waste of oil while the engine was standing. The modern practice for high-speed lubrication everywhere was to deliver a small amount of oil continuously over the whole length of the bearing surface. It was not judicious to trust one oil cup where two were possible. Cups or oil pockets were solid (cavities in the metal) rather than separate, and grooves were liberal in size and number. Strainers and oil covers over all pockets were desirable. The report closed with a description of the oils and oil tests used by a number of roads.

The report was ordered received and the report of the committee on Boiler and Firebox Steel was then taken up by special order of the members.

Boiler and Firebox Steel Specifications.

The specification for boiler and firebox steel should be such as to secure thoroughly good and reliable material, excluding that of inferior quality, and, at the same time, should be sufficiently broad to allow any reputable maker to comply with its requirements. It was found that there was a very decided difference of opinion between the different members of the committee as to the best quality of steel for fireboxes, some favoring a soft steel with an ultimate strength of from 50,000 lbs. to 58,000 lbs., while the majority preferred a harder quality with an ultimate strength of from 55,000 lbs. to 65,000 lbs. Still greater differences of opinion were shown regarding the chemical composition which such steel should have.

Dr. C. B. Dudley, Chemist, Pennsylvania R. R., advised a moderate specification as more likely to be satisfactory than one in which the limits were narrowed down too closely. He stated that the phosphorus limit could be set as low as 0.02 and still be worked to by the basic process and also by the acid process with one or two makers, but considered it unwise to set the limit so low, especially since many fireboxes which had given good service were made of steel having 0.07% of phosphorus. As regards sulphur he considered that this was largely a question of fuel; where coal was used the percentage of sulphur would be greater than where natural gas was used, so that in order not to discriminate against localities he favored placing the sulphur limit at 0.05% with 0.02% desired. Manganese and carbon were both hardeners, but if the tensile strength and one of these elements were limited the other element would be limited also. From the user's standpoint he considered it preferable to obtain the hardness from carbon. Not much was known about silicon, but it was believed to be more readily oxidized than iron at high temperatures and for this reason steel containing it was more liable to disintegrate.

Having obtained this opinion from Dr. Dudley, the committee endeavored to get positive information concerning the performance of hard and soft steel fireboxes in actual practice. From the records of several hundreds of worn out fireboxes it was found that the tensile strength varied from 77,000 lbs. to a little over 50,000 lbs., while the mileages varied from 500,000 to a little over 50,000 miles. The results of the examination were quite conflicting, as was to be expected, considering that the use of the firebox on the road had more to do with its life than the original quality of the metal of which it was constructed. It was found, however, that hard and soft steel might be found in both long and short-lived fireboxes. The weight of evidence was, however, toward steel having a tensile strength of 60,000 lbs., as giving the best results.

The tensile tests of firebox sheets both before and after service indicated very strongly a lower strength in the old than in the new sheets. The committee was aware that there was a prejudice against hard steel as more liable to crack, but offered the suggestion that improved methods of boiler making, such as machine flanging, and more intelligent methods of boiler washing, were removing many of the earlier difficulties, and thought that after it was once flanged, steel of 60,000 lbs. tensile strength would give better results than that of 50,000 or 55,000 lbs. strength. In holding threads the hard steel was superior. There was also less bagging between stay bolts with its use. The specifications recommended were as follows:

Test Pieces.—Test pieces, one from each plate, shall be in rough 2 ins. wide and 36 ins. long, and as nearly straight and free from twist as possible, and must in no case be annealed. Each plate shall bear the maker's name, either rolled or stamped. The heat number and in addition, such identification marks as may be specified by ordering road, shall be put on each plate and test piece.

When inspectors are present at mills, butt strips may be cut from any plate, provided such sheets are represented by test coupons. Where inspectors are not at mills, they must as far as possible be cut from a single sheet as rolled, and each sheet cut into butt strips will be represented by a test strip. All butt strips as well as test strips shall bear the heat number.

Shear Marks.—Each sheet shall be accompanied by test coupon, 2 × 36 ins. long, attached at one end sheet. To facilitate future matching, should it be necessary, both sheet and coupon shall be stamped twice across the division line with a shear mark, either round, oval, or of other agreed form, which mark should be not less than 3 ins. across.

In cases where one large plate is cut into several smaller ones, all represented by one test piece, the same shear mark shall be stamped across each division line in two places before shearing, so that subsequent identification may be readily performed.

Dimensions.—Plates must be of shape and dimensions ordered. Any excess in weight over that corresponding to the dimensions in the order, greater than that specified in table below, will not be paid for. In computing weight of plate from dimensions, 1 cu. in. will be taken as weighing 0.2836 lb.

Allowance for overweight over that corresponding to dimensions, shall be as follows:

Thickness of plate, ins.	¼.	5-16.	⅜.	7-16.	½.	9-16.	⅝.
Per cent. allowance	10	8	7	6	5	4½	4

Plates measuring 1-100 in. less in thinnest part than that ordered, and all plates which show seams or cracks at the sheared edges, or which have cracks, slivers or depressions in the surface, or which develop defects in working, will be rejected. Rejection on account of thinness is to be made only after measurement of the actual sheet. Test pieces, being prepared from the edge of sheet, are liable to be thinner than the main sheet.

Test pieces when finished will be 1½ ins. wide in test section, and of full thickness of plate, and may be either parallel sided or of reduced section, and prepared either by longitudinal planing or milling. Where reduced section is adopted, the distance between bottom of fillets shall be not less than 9 ins. and radius of fillets shall be not less than ½ in. and preferably more. Elongation will be measured between tram punch marks originally 8 ins. apart, and on reduced sections placed approximately equidistant between fillets. In parallel sided sections, the tram punch may be applied at more than one point to insure breakage occuring between the marks.

Special Requirements for Shell Steel.—Shell steel shall have a tensile strength of from 55,000 to 65,000 lbs. and an elongation of not less than 20% in 8 ins. Test pieces having rough edges removed by filing, grinding or machining, shall, without annealing, bend over itself both while cold and at a cherry red heat and dipped in water at 80° F. without showing cracks and flaws in the outside edge. There shall be no chemical requirements.

Special Requirements for Firebox Steel.—The metal is to have a tensile strength of 55,000 lbs. to 65,000 lbs., with 60,000 lbs. desired, and an elongation of 28% in 8 ins., preferred. The chemical composition desired is: Carbon, 0.18%; phosphorus, not above 0.03%; manganese, not above 0.4%; sulphur, not above 0.02%; silicon, not above 0.02%. Plates will be rejected having a tensile strength less than 55,000 lbs., or over 65,000 lbs.; an elongation less than 22% in 8 ins., and in ¼-in. plates less than 20%; a failure to stand bending and quenching test as given for shell steel; any seam or cavity more than ¼ in. long in any of the fracture or homogeneity tests. Plates shall also be rejected having carbon over 0.25%, or below 0.15%; phosphorus over 0.035%; manganese over 0.45%; silicon over 0.03%, or sulphur over 0.045%.

The homogeneity test shall be made in the following manner: A portion of the broken test piece shall be nicked with a chisel on opposite sides alternately, the nicks being about 1 in. apart, and the piece broken by a number of light blows, the bending being away from the nicks. If the laminations are more than ½ in. long, the piece shall be condemned. The object of this is to open and reveal seams, due to failure to weld up, or to foreign interposed matter, or cavities due to bubbles in the ingots.

In explaining the specifications, the report stated that the reasons for choosing test coupons 36 × 2 ins. in rough, of which a section of at least 8 ins. between grips was to be prepared 1½ ins. wide, were that such dimensions would make two test specimens if check testing was desired, or it would furnish one tensile test specimen and one for bending and quenching tests. A specimen finished 1½ ins. wide and of a thickness equal to the thickest sheets used in locomotive boilers would be within the capacity of a 100,000 lbs. testing machine, and a 50,000-lb. machine would serve for nearly all that are used. The committee satisfied itself by tests that specimens 1½ ins. wide prepared from coupons 2 ins. wide and of thickness of ½ in. did not not appear to be affected by shear hardening.

A minority report was also presented which proposed that the tensile limits of firebox steel in the new specifications be altered to read from 50,000 to 58,000 lbs. per sq. in., respecively, and that the carbon be reduced to from 0.10% to 0.20%; the elongation be 20% for ¼-in. plates, and 24% for 5-16-in. thick and upward in 8 ins. in length.

The discussion of the report on Boiler and Firebox Steel and the remaining proceedings of this convention will be given in our next issue.

MASTER CAR BUILDERS' ASSOCIATION.—(Concluded from p. 495.) The last report taken up at Tuesday's session was that of the committee on Safety Chains for Freight Cars, which was read by the chairman, Mr. H. Coulter (Phil., Wilm. & Balt.)

Safety Chains for Freight Cars.—In answer to the letter of inquiry sent out by the committee regarding the standard location, arrangement and attachment of safety chains to suit all classes of freight cars, replies were received from 45 railways representing 569,261 cars. Of the total number, twelve roads, representing 226,351 cars, favored the use of safety chains, and 33 roads, representing 342,910 cars, were either against their use or regarded the subject as not material. Sixteen of the 33 roads did not consider the use of safety chains necessary on freight cars of any description. Only five roads reported the actual use of safety chains and how they were applied to cars used in transporting structural iron, long timbers, piles, etc. The committee stated that in its opinion safety chains were necessary only on flat and low-sided gondola cars which were frequently coupled together to carry loads extending over two or more cars. The general use of such chains was not recommended for any class of cars, but with the view of having them interchangeable when used the committee submitted a standard.

The discussion which followed the report confirmed the opinion expressed by the committee that safety chains could be applied with advantage to freight cars which were used to carry lading extending over two or more cars, but that their general application to all classes of freight cars was unnecessary, especially as the use of M. C. B. couplers and automatic brakes on freight cars was rapidly increasing. Objection was, however, brought against the standard proposed by the committee on account of the distance at which the chains were placed from the center line of the car, viz., 27 ins., and on the motion of Mr. A. M. Waitt (L. S. & M. S.) the committee was ordered to reconsider this point and to report later during the convention.

Wednesday's Session.

The first business at the Wednesday morning session was the reading of the report of the committee on Wheel and Flange Gages preparatory to the discussion of the rules of interchange. The larger part of this report consisted of a reprint of the paper on Wheel Flanges read before the Western Railway Club in January, 1893, by Mr. G. W. Rhodes (Eng. News, Feb. 2, 1893), and a report of a committee appointed at about the same time to investigate the same subject, by the Pennsylvania R. R. Co. Taking these two papers as a basis the committee recommended the following measurements and wheel and flange gages for adoption as standards:

Wheel and Flange Gages.—In making measurements the following definitions were recommended:

(1) Gage of Track.—The shortest distance between heads of track rails.

(2) Track Rails.—The two main rails forming the track.

(3) Base Line for M. C. B. Wheel Gages.—A line parallel to the axis of the wheel drawn through the point of intersection of the tread and a perpendicular line through the center of throat curve.

(4) Inside Gage of Flanges.—The distance between the two flanges of a pair of wheels measured on a line parallel to the base line and ¼ in. nearer the axis of the wheel.

(5) Gage of Wheels.—The distance between the outside flanges of a pair of mounted wheels measured on a line parallel to the base line and 17-64 in. further from the axis of the wheel.

(6) Thickness of Flange.—The distance measured on the base line from the point of measurement of the inside gage of flanges to the point of measurement of gage of wheels.

(7) Width of Tread.—The distance measured on the base line from the point of measurement of the gage of wheels to the outer edge of tread.

(8) Check Gage.—The distance measured on the base line from the point at which measurement of inside gage of flanges is taken on one wheel to the point at which measurement of the gage of wheels is taken on the mate wheel.

(9) Over-all Gage.—The distance from the outer edge of one wheel to the outer edge of the mate wheel.

The standards recommended for adoption, using these definitions were as follows:

Gage of truck	4 ft.	8½ ins.
Inside gage of flanges	4 "	5⅝ "
Gage of wheels	4 "	8¼ "
Thickness of flange		1⅝ "
Width of tread		4⅛ "
Check gage	4 ft.	6⅛ "
Over-all gage	5 "	4⅝ "

The gages proposed by the committee for making flange measurements are shown in Figs. 1 and 2. These gages were laid out with reference to the base line. In conclusion, the committee recommended:

(1) That for mounting wheels the check gage (Fig. 1) be used without delay.

(2) That all wheels should be purchased subject to the limits of flange gages (Fig. 2).

(3) That the Abt system of gaging be continued for wheels manufactured prior to some date to be established by the M. C. B. Association, but for wheels manufactured after that date the new gages be used.

(4) That the present worn flange gage be continued.

(5) That the guard rail gage, abandoned by the Association in 1893, be re-established as standard.

(6) That the limits of 4 ft. 5 ins. and 4 ft. 5⅜ ins., between which gages cars are acceptable in inter-

change, be reduced to come nearer to the standard 4 ft. 5⅝ ins.

On the motion of Mr. R. E. Marshall (Phil., Wilm. & Balt.) the further consideration of the report was ordered postponed until Wednesday's session to be then resumed in discussing the rules of interchange relating to wheel and flange gages.

It being now within a few minutes of the time set for the discussion and revision of the rules of interchange the convention proceeded to their reading and consideration by sections. This work as usual brought

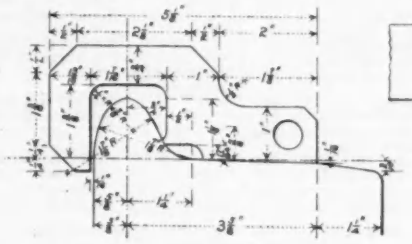


Fig. 1. Flange Limit Gage for New Wheels.

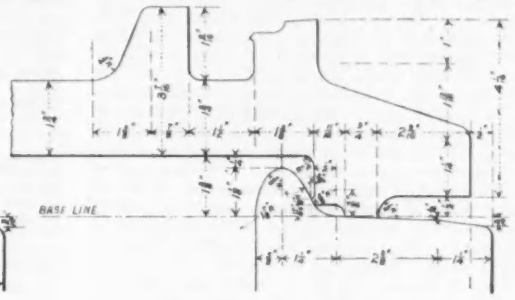


Fig. 2. Check Gage.

out a very free discussion by the members on proposed and needful changes. As the revised rules will soon be ready for distribution no attempt is made to note the various changes here.

The proposed changes which excited the most discussion, and one of which was adopted, were the recommendation of the Central Railroad Club that couplers cracked at the corners of the shank immediately back of the horn or guard arm should be added to the safety list (see Sec. A, Rule 3, Rules of Interchange), providing such cracks did not exceed ¾ in. each way from the angle. Also the motion of Mr. J. N. Barr, that to the defects for which owners are chargeable should be added drawbars or couplers, drawbar timbers, drawbar springs, and sills cracked over transoms, unless such defect was caused by derailment or wreck. A number of the members objected to the recommendation of the Central Railroad Club, in that the cracks once developed would rapidly increase until finally the shank would break and the head would fall onto the track, entailing a serious wreck. It was considered by them that the cracks were at the most dangerous point of the coupler owing to the heavy and constant shocks to which it was subjected. On the other hand, Mr. John Mackenzie (N. Y., Chic. & St. L.) and Mr. S. A. Crone (N. Y. C. & H. R.) and others stated that this rule had been adopted by the roads interchanging cars at Buffalo, N. Y., at the recommendation of the joint inspectors at that point, and although it had been in operation several months no accidents had yet occurred. It was formerly the practice to refuse all cars at this point whose couplers showed cracks of more than ½ in. in the shank as specified, but experience had proved that in doing this a great injustice was being done, as such couplers stood well up to their work, and no accidents had resulted. As far as the danger of the head falling on the track and causing a wreck was concerned, that did not amount to much, as most of the couplers broken were broken in switching. Couplers cracked ¾ in. in the the shank as specified had stood a tensile stress of 125,000 lbs. in actual test, which, considering the fact that many new couplers failed under 90,000 lbs., was a pretty good indication that no serious danger resulted from the cracks. On the motion of Mr. Geo. W. West (N. Y., Ont. & Wn.) the recommendation of the Central Railroad Club, as given above, was ordered embodied in the rules of interchange.

In defense of his recommendation that the cost of repairing drawbars and couplers, drawbar timbers, drawbar springs and sills cracked over transoms be chargeable to the owners, Mr. J. N. Barr (Chic., Mil. & St. P.) said that he had been studying this question for some time and recommended the change as a step toward what he thought might ultimately come with advantage, i. e., that all repairs to cars be chargeable to their owners. If his recommendation was adopted it was true that railways would get a number of bills which they did not now get, but at the same time they would make out against other roads a number of bills which they did not now. Again, the ease and rapidity of interchange would be greatly increased and the quick movement of freight facilitated. Inspectors' bills would be decreased and in the long run the cost of car maintenance would be also decreased. In making the recommendation the idea was to take a few of the important items of repair and try them for a year; if the plan worked well to continue it and if it did not to abandon it.

The discussion was continued by Messrs. J. W. Marden (Fitchburg), Mr. P. Leeds (L. & N.), Mr. C. A. Schroyer (Chic. & No'w'n.) and Mr. A. M. Waitt (L. S. & M. S.), all of whom approved Mr. Barr's remarks in the main. Mr. F. D. Casanave (Penn.) objected to the recommendation on the score that it enabled companies having a small equipment to use the cars of other roads and then repair them at the owner's expense. The mileage charged was now ¾ ct. per mile, but if the recommendation was adopted this charge would have to be increased in justice to the owners of large equipment.

On a vote of the members by cars represented, Mr. Barr's proposed addition to the rules was rejected; the vote being 465 to 386. The session was then adjourned.

Thursday's Session.

The revision of the rules of interchange was resumed at Thursday's session at the point where the work was discontinued on the previous day. Several minor changes were made in the rules pertaining to the marking of wheels and axles, and a committee consisting of Messrs. R. E. Marshall, Joel West and J. H. McConnell, was appointed to consider the question of revising the prices allowable for repairs as given in the rules, this committee to present its report at Friday's session. The reading of the reports of committees was then resumed. The first report was that on Road Tests for Brakeshoes.

Road Tests for Brakeshoes.

The report showed that the following numbers and kinds of brakeshoes were now being tested:

Kind of shoe.	Total number.	No. on cast iron wheels.	No. on steel wheels.
Hard, cast iron	48	32	16
Soft open hearth steel	52	32	20
Hard " " "	52	32	20
Malleable iron	48	32	16
S. T. malleable iron	44	28	16
C. W. " "	44	28	16
Congdon	48	28	20
Sargent special	44	28	16
Meehan	48	28	20
Lappin	48	28	20
Safety	44	28	16
Soft steel	48	28	20
Wrought iron	48	28	20

These shoes had been placed on cars in actual service opposite soft cast iron shoes of uniform quality which were to act as reference shoes. Up to the present time none of the tests had been completed, as none of the shoes had worn out.

In presenting the report, Mr. R. H. Soule, (N. & W.) the chairman, stated that many of the tests would probably be completed within the next three months, and that by Nov. 1 the committee would probably be ready to announce the results. As they were being carried out, these tests were nothing but tests of the wearing qualities of the various kinds of shoes as compared with cast iron shoes. Every care had been taken, however, to have the cast iron shoes as nearly uniform in quality as possible, so that the results obtained with the different shoes could safely be compared with each other. It had been intended at first to introduce several refinements into the tests, such as calibrating the brake springs and measuring the wheel wear, but it was finally concluded that the results obtained would hardly be worth the trouble. The report was accepted and the committee continued for another year.

The convention then proceeded to the reading of the report of the committee on Laboratory Tests of Brakeshoes.

Laboratory Tests of Brakeshoes.

The committee began its work in August, 1893, and up to the present time had got only so far as the construction and erection of the apparatus for making the tests. This apparatus is fully described in another column. The committee stated that the work of making tests was to be begun immediately and that by the time of the annual convention of the association in 1895 the results would be in shape for presentation.

In proposing the continuation of the committee for another year, Mr. J. N. Barr spoke highly of the work which had been done by it and congratulated the association on the prospects of the vast amount of valuable information which the work promised. It was voted unanimously that the committee be continued and the expense incurred in providing the necessary apparatus be paid from the treasury.

The discussion of the report of the committee on wheel and track gages, which had been laid over from the preceding session, was next taken up. Mr. J. N. Barr, the chairman of the committee, read the recommendations proposed, and illustrated and explained the various gages by means of models. In presenting the report, Mr. Barr stated that there were several points which properly come up in this connection which the committee had not taken up in its report. One of these was the proper mounting of the first wheel which had to be used as the basis for gaging the location of the mate wheel, and another was the mounting of second-hand wheels where the flanges were worn. For the first case he was of the opinion that a pointer placed at the centre of the rod connecting the two check gages, was the best thing, as by applying this pointer to the centre of the axle the first wheel could be mounted properly.

Mr. J. M. Wallis (Penn.).—As to mounting second-hand wheels, and starting with the first point of the wheel, I think we may consider that the over-all measurement, 4 ft. 8½ ins., is only intended, and will only be practiced, for new wheels. Second-hand wheels will never meet those dimensions in the over-all gage. You can mount these wheels from the end of the axles, just allowing the difference that exists between the worn flange and a perfect flange; mount it that much further in. In mounting second-hand wheels you would not get the same distance between the backs as with new wheels. One will be pressed in half the distance that is worn off the flange. The distance from backs and distance over all will come right, as long as you keep the correct measurement from the back of one wheel to the throat of the other, and it can be located in that way.

Mr. J. W. Marden (Fitchburg): Would it not be right to measure it from the back side of the flange? We are measuring it in one instance from the back of the flange to the throat of the wheel. Why would it not be right to measure from the back of the flange in both cases? That is our practice at the present time. We have a T square, and we mount our first wheel from the back of the flange to the center of the axle, and we intend to have a standard flange.

Mr. R. E. Marshall (Phil., Wilm. & Balt.).—Investigations have shown that as the thickness of the flange is decreased, in order to obtain the best results, it is desirable to increase the distance between the backs, and therefore it is desirable to hold to that dimension of 4 ft. 6⅛ ins. from the back of one flange to the face of the other. If you mount a wheel with a flange originally 1 7-16 ins., which has worn down to 1 5-16 ins., you may as well mount it 4 ft. 6⅛ ins. and put it in shape to avoid blows on guard rails.

Mr. G. W. Rhodes (C., B. & Q.).—One of the difficulties in the matter of wheel gages has been the two track gages in use, viz. 4 ft. 9 ins. and 4 ft. 8½ ins. I believe the time is coming in this country when we will have a standard track on account of these irregularities in our gage which have been hidden until this committee has got to work and brought out the defects. There is no greater safety appliance that can be produced than having a uniform gage of track. One thing is to mount the wheels in accordance with the recommendations of the committee; but you must also attend to the track. It can be accomplished by changing the guard rail, and having the 2-in. opening in the frog. I walked down the track here at Saratoga the other day. I ran across one frog and guard rail. The guard rail was 2¼ ins. from the gage rail. I do not cite that as being particularly pertinent to this neighborhood. Perhaps if the same investigation were made on the line I represent it would be found just as bad. Some investigations were made in Chicago recently, and in 72 measurements taken, the distances of the guard rails from the gage rails were found to be from 1½ to 2⅝ ins. We should have the co-operation of the American Railway Association in this matter.

Mr. M. N. Forney.—About ten years ago I read a paper upon this subject when it was in a state of even greater confusion than it is now. The great trouble encountered is that there is not the co-operation there should be between the car builders and the engineers who have charge of the permanent way. A perfect solution of the question would be possible with this co-operation. I agree with the suggestion that this matter should be brought to the attention of the American Railway Association, so that the officials could call in both departments and confer together and have some agreement with reference to it. We ought to confer with the American Railway Association first, however, and then submit the matter to letter ballot. The great trouble often is in the formation of the head of the rail. On the Lehigh Valley the corner of the rail is on a ⅝-in. radius. A pair of wheels that would run quite

snugly on the Lehigh Valley, with a radius of ⅝ in., would have much more play on the New York Central, where it is 5-16 in. The corner of the rail should be of a standard size as well as the flange of the wheel. The jurisdiction of this society extends only to the cars. I think it would be proper to go to the American Railway Association, state what is wanted and secure the co-operation of the Maintenance of Way Department.

The convention voted that the recommendations be submitted to letter ballot and that a committee of three be appointed to confer with the American Railway Association with the view of securing its co-operation in establishing definite rules in regard to gage of track, guard rails, frogs, etc. Messrs. R. E. Marshall, J. N. Barr and G. W. Rhodes were appointed as the committee. The convention then adjourned until Friday.

Friday's Session.

At the opening of the Friday morning session a resolution was introduced amending Section 2 in the interchange rules under Defects of Mounting Wheels and Axles to read 4 ft. 5⅝ ins. between flanges instead of 4 ft. 5¾ ins., which was passed. It was also voted that the amended rule should not go into force until after Sept. 4, 1894. In the discussion which preceded the passage of the amendment Mr. A. M. Waitt said that during the six months prior to June 1 the Lake Shore & Michigan Southern R. R. had had a large number of cases of cars running off the track. The peculiar feature of these cases was that the accidents were all confined to one class of cars. An investigation was made and it was found that a large majority of the wheels were thick flanged, the gage of the wheels being from 4 ft. 5-11-16 ins. to 4 ft. 5 6-18 ins. They simply came to the point of a frog, rose up and rode over it, dropping off at the other end. He heartily supported making the limit of gage 4 ft. 5⅝ ins.

The convention then proceeded to the reading of the reports which had been referred back to the committees for amendment at the previous sessions. The first taken up was that of the committee appointed to revise the list of prices in the rules of interchange. The committee was divided on this report, a majority and minority report being presented. The majority report was signed by Messrs. R. E. Marshall and Geo. W. West and was as follows:

Your committee has considered the question of increasing the prices of material as suggested, and a majority of the committee is of the opinion that no change should be made in the present prices except as follows: Adding to the list one M. C. B. standard journal bearing for 3¾ × 7-in. box to weigh 10 lbs.; one box or stock car, half side door, applied, $3. It also recommends removing from the list the prices for M. C. B. couplers and attachments and inserting immediately under the list a new paragraph to read: M. C. B. couplers or parts of same to be charged at current market prices, which are to be quoted by the secretary semi-annually. Credits to be allowed at scrap rates as given in above list.

The minority report was signed by Mr. J. H. McConnell and was:

In view of the fact that west of the Missouri River the price of labor and material is largely in excess of that paid for work and material in the Eastern states, the North and Western part of the United States roads in making repairs to cars under the present M. C. B. prices do so at a loss. I would recommend rule 26 be amended, to read: An additional price of 10% be allowed to M. C. B. price list for all labor and material furnished by railways in the states of Kansas, Colorado, New Mexico, Texas, Arizona, Nevada, California, Oregon, Washington, Montana, Idaho, Utah, Wyoming and Nebraska.

In defense of his report Mr. McConnell said that west of the Missouri River railways paid 25% more for labor than was paid east of the Missouri River. They also pay more for material. Car repairers were paid $2.25; carpenters, $2.75 and $3. They were doing work out there at a loss. They did not ask for charity, but for justice, and to be placed on an equal footing with the people in the East. The railways in the East were doing the work under the M. C. B. rules at a profit; those in the West were doing it at a loss. His road was paying $8.75 for a wheel at Omaha and $11.75 at Portland. The Rio Grande road and the Southern Pacific paid more. He paid $1.60 per 100 lbs. for casting, and used 13,000,000 lbs. a year. At other places in the West the price ran from $1.75 to $2.25. The M. C. B. prices allowed only $1.60 per 100 lbs. They were furnishing material at less than it cost, and the Rio Grande, Southern Pacific, Northern Pacific, and the roads in Texas were doing the same. He thought it right and just that they should be compensated for the work. He understood that in this section wheels could be bought for $4.50 and $5. He could not afford to run a wheel of that kind over his road, with its steep grades, but required a first-class wheel and had to pay for it.

Mr. J. T. Chamberlain (B. & M.).—It seems to me the last speaker is asking for an advantage which none of us has. The object of fixing these prices is that there will be no particular advantage in the different sections of the country. The prices are made so that no money will be made in the repairs of foreign cars, after you have summed up the total for a year. We may be in a hole one month, but we will square ourselves the next month. If their work costs 25% more on every piece of work we do for them, they are getting the benefit of prices 25% cheaper than theirs. It seems to me the things balance. If they are repairing Lake Shore cars, the Lake Shore is repairing their cars, and they are doing it much cheaper than they could do it down on their own premises. I think the rules are about right.

Mr. P. Leeds (L. & N.).—We pay mileage for the use of foreign cars; that is about the equivalent of the maintenance of our cars. We get mileage to compensate us for the use of cars while they are on other roads, and a slight revenue. Do these gentlemen propose to pay us for the extra expense that we go to to maintain cars while on their road? If not, then I do not think there is any reason why they should ask us to send cars to them at a loss to ourselves.

Mr. J. N. Barr (Chic., Mil. & St. P.).—If the M. C. B. prices are, as Mr. Chamberlain says, such that he does not make any money on foreign cars repaired, the conditions are all right as they are; but the fact is, we all make a little money on the foreign cars we repair. There is no use saying we do not. At points west of the Missouri River they lose a little money. I do not know but that it would be perfectly fair, as we intend to embrace this whole country in our arrangements, to allow them a 10% increase on the prices. We will make it on the foreign cars we repair.

Mr. J. W. Marden (Fitchburg).—With the prices that Mr. McConnell has mentioned, I do not think his road is any worse off than are the roads in the far East. If we want to get castings at $1.50, we have to send to Buffalo; our foundries in the East charge 2 and 2¼ cts. per lb. In the majority of cases we are losing on the prices we have in the far East. As to prices for labor, our repair men run from $1.75 to $2.25. I think the prices as we have them are equable for all of us.

Mr. J. T. Chamberlain.—I said the M. C. B. prices were regulated so that all sections of the country would be protected, and the general result intended was that we should not make any money in these repairs. I kept the matter of repairs on foreign cars for three months, half a year ago, as to the actual cost, under the M. C. B. rule. We were ahead $40 on a three-months' record. It is as Mr. Marden says. We are in a country where we cannot get lumber as cheap and materials as cheap, and it is costing us in the far East a good deal more money to do the work and purchase the material than it does in the Western states; and even more than it does in the Middle states. I do not think we should change these prices at all. We come out about even.

Mr. R. E. Marshall (Phil., Wilm. & Balt.).—It seems to me that the only equitable way of reconciling the views expressed would be to wipe out this list, and say that material shall be charged at market prices, plus freight charges. We can imagine what sort of a mess we would get into with our bills in that case. If we start in to try to make varying prices for different sections of the country, we will have to make special concessions for a good many more places than the lines west of the Missouri River. The fact that the cars on the lines west of the Missouri River from the lines east are repaired at a loss is not for the benefit of the Eastern lines. They are for the service of the lines in those states; they are in place of cars of their own which they would be required to have to do the business if they were not using the foreign cars. It would cost them just as much to make repairs to their own cars as to foreign cars.

On the motion of Mr. Waitt the majority report, as given above, was adopted.

Mr. H. Coulter then read the report of the committee on Safety Chains on Freight Cars, which had been ordered reconsidered. The committee considered that no change should be made, and the report was adopted on a motion that the proposed standard should be submitted to letter ballot.

The convention then proceeded to the reading of the remaining committee reports, of which there were eight. There was almost no discussion on any of them. These reports are here given in abstract in the order read, except that of the committee on tests of M. C. B. couplers, which is given in another column.

Heating Passenger Equipment.

Answers were received to the committee's letter of inquiry from 30 roads, representing 30,011 miles of line. These showed 5,869 cars equipped with steam heating apparatus or other improved methods of heating, and 6,432 cars not so equipped. Answers from 13 other roads, representing 16,947 miles, showed 2,414 cars not equipped, making the total cars equipped 5,869 and unequipped, 8,846.

Ventilation of Passenger Equipment.

The conditions for proper ventilation were described at some length in the first part of this report. These showed that in nearly all passenger cars the ventilation was very poor. It was stated that the majority of so-called ventilators in use were of very little value. The report closed with a table showing the results of a series of tests made on ventilators of different patterns. These results were as follows:

Name.	Cu. ft. of air ex. per min., wind at 49⅝ miles per hour.	Back draft.	Remarks.
Cone cap	29	None.	Free natural draft.
Cone and apron	12	"	" " "
Canopy	4	Very slight.	Nat. draft badly obstructed.
Tornado canopy	56½	At angles from 65° to 90°	Nat. draft much obstructed.
Dished cap	63	At angles from 70° to 90°	Free natural draft.
Moore	49	None.	Free natural draft.
Duplex	54½	"	" " "
Roe	58	"	Nat. d'ft only fair.
Stasch	86	"	Nat. d'ft very free.
Star	83	"	" " " "
Globe—erect	71	"	Nat. d'ft mod. free.
Globe—horizontal	80	"	Nat. d'ft quite free.
World	72	At angles from 40° to 50°	" " " "
Torpedo	84	None.	Nat. d'ft very free.
Deflector—cast	90	"	Nat. d'ft mod. free.
Deflector—sheet	88½	"	" " "
Creamer Eureka	34	"	" " "
Creamer Automatic.	34½	At 48° to 90°	Nat. d'ft fairly free.
P. R. R. Induction.	43	None.	Nat. draft badly obstructed.
Trailing sash	67	At angles from 65° to 90°	Nat. d'ft quite free.
Drop sash	43½	At all angles from 5° to 90°	Nat. d'ft very free.

Lighting Passenger Equipment.

The committee appointed failed to report and the secretary presented in its place the results of some investigations which he had made to determine the extent to which various systems of lighting were being used. Reports had been obtained from 45 different railways and passenger car companies. Very little of value was given in many of these reports. Such figures as were obtained, however, showed that all or many of the cars of every road were lighted by oil lamps. Some of the roads now using oil stated that they were changing to the Pintsch light and one stated that all new equipment was having the Frost light put in. The light most commonly used next to oil was the Pintsch light. Ten roads reported the Frost light in use. A few used coal gas and two, the Chicago, Milwaukee & St. Paul and the Chesapeake & Ohio, reported 95 and 59 cars, respectively, lighted by electricity. Five other roads had made experimental trials of electric lights, and the Pullman Palace Car Co. reported 108 cars equipped with electric lights. The Chesapeake & Ohio Ry. reports that its experience with secondary batteries has been very satisfactory, and states that an average of 148.8 c. p. per car per 14 hrs. is produced at a cost of 94.9 cts., and the Chicago, Milwaukee & St. Paul states that the cost per car per day of a seven car train is 88 cts.

Lubrication of Cars.

Replies to the committee's circular letter were received from 46 roads, representing 576,000 cars. In many respects the answers were disappointing, as they furnished but few facts, and these in fragmentary form. They showed, however, that almost every kind of oil, from crude oil at 5 cts. per gallon to refined Galena oil at 35 cts. per gallon, was used. As near as could be calculated the cost of oiling per 1,000 miles run varied from 6 cts. to 41.6 cts. for passenger equipment and from 6 cts. to 26.3 cts. for freight equipment. Out of 45 roads, 21 used special cooling compounds to prevent hot boxes. It was significant that all but four of the roads using cooling compounds used a cheap grade of oil. The replies showed generally fair results with these compounds. Only a comparatively few roads kept a record of the number of hot boxes, but the records of those that did showed one hot box for about every 20,000 miles run on passenger equipment. The best record was one hot box in 1,000,000 miles run, and the poorest, one in every 5,300 miles run. A curious fact was that the three roads showing the best records and the three showing the poorest records used the highest grades of oil. The replies showed the number of gallons of oil used per 1,000 miles run to be from 4⅛ to 0.6 gallons for passenger, and from 2¼ to 0.5 gallons for freight equipment. Most roads used about 2 gallons per 1,000 miles on passenger equipment. As to the best kind of packing, 17 roads favored all wool waste, 9, all cotton waste, and 16, wool waste for passenger and cotton waste for freight equipment. The practice of 33 roads out of 45 indicated that all wool waste was the best material for packing and the report recommends its use. In regard to the comparative freedom from heating of steel and iron axles, opinion seemed to be about equally divided. The report considered that while steel axles were probably freer from flaws and seams, yet the looser grain of the iron axles held the oil better, and, as a consequence, it was more difficult to lubricate steel journals if they were loaded anywhere near their full capacity. The replies showed the subject of the proper mixture of metals for jour-

nal bearings and the kind and quality of metal for linings to be in a very undecided state. The committee concluded, however, that lead or lead with a very small percentage of antimony was considered the best metal for lining bearings. Taking the replies as a whole the report gives the most important features in securing proper lubrication to be: (1) Oil, (2) waste, (3) journal bearings, (4) axles, (5) general construction and maintenance of trucks, (6) instructions to shop foremen and inspectors as to care, repairs and reports in connection with oiling of cars and attention to hot boxes.

Only the best quality of oil should be used with woolen waste and no waste should be used which had not been soaked in oil at least 24 hours. A fruitful source of hot boxes was poor journal bearings. This was due to mechanical defects more often than to the character of the bearing metals used. Hence it was important to secure good metal and good workmanship, and to use exact gages in setting and testing journals and bearings. It was equally important that a good quality of metal and workmanship should be used in the axles. Probably the most fruitful cause of hot boxes was the improper putting together of the truck. Pedestals should be plumb and square. The equalizers must be square in the feet and parallel, and must have slight allowance made for the spring in the car under load. The equalizer springs must be so located that the thin end of the spring will equalize the weight on each side of the center line, otherwise the foot of the equalizer will bear unevenly on the top of the oil box. The oil box covers must fit reasonably well. Dust guards must be close fitting and made entirely of, or lined with, some durable material like rawhide, or vulcanized fiber.

In addition a complete and well defined set of rules regarding oiling and packing should be made for the guidance of inspectors, oilers, brakemen and conductors, etc., and a complete record kept of all hot boxes, so that the weak points may be discovered. The committee recommended a set of gages to be used in setting and repairing journal boxes, and that the present form of the 3¾ × 7-in. journal bearing be changed to correspond to that of the 4¼ × 8-in. bearing.

On the motion of Mr. R. E. Marshall it was voted that the recommendations of the committee on gages and the change in the form of the journal bearing noted be submitted to letter ballot and those regarding further lines of investigation referred to the committee on subjects. It was also voted to continue the present committee another year.

Air-Brake and Hand-Brake Apparatus on Cars.

The committee received 40 replies to its circular of inquiry, representing about 600,000 cars, from which it found:

That, as a general rule, very little systematic or thorough testing or caring for freight air-brakes is done after the cars leave the main shops.

That only eleven companies out of the 40 have any testing plants whatever outside of their main shops, and those only at the larger repair points.

That 13 companies report that they insist on the conditions for air-brakes prescribed in the rules, and 27 do not.

That but three companies have any air-brake testing plants at interchange points.

That 28 companies out of the 40 make their entire air-brake inspection by observation only.

That most of those that make an inspection by air-brake engine simply make the cars safe to run, and take care of such air-brakes only as will not delay the movement of cars.

That only seven companies report that they have any system of marking cars that have air-brake defects which are not remedied when discovered.

That 27 companies have no reports whatever from trainmen.

With the lack of thorough inspection by test at interchange and division points, the absence of testing plants at outside repair tracks, and the need of an effective system of marking cars which are allowed to run after being found defective, it is obvious that the condition of our freight air-brakes must rapidly deteriorate unless means and methods of doing the work, commensurate with the importance of the subject, are soon inaugurated.

After the apparatus has been properly applied to cars, its efficiency can only be maintained by rigid inspection and repairs at every opportunity, and this can only be attained in a satisfactory manner by the introduction of air plants in which a constant and copious supply of air at the standard pressure is maintained by some power and distributed through shops, repair tracks, and inspecting yards, so that it can be conveniently connected to any train or car without any extra switching. If it cannot be extended to the inspecting tracks, it should at least be placed on all repair tracks of any importance at the earliest moment. These tests only, if properly maintained, would insure a rapid improvement, and help to a very large extent in maintaining the brakes. Some companies will not permit any car to leave their yards with defective air-brakes; others, and these, of course, a very large majority, consider that a car in which the hand-brakes are effective, even though the air-brakes are inoperative or defective, to be no worse than a car without air-brakes, and permit it to go forward, in many cases in a defective condition, expecting that the defects will be detected and taken care of at terminals. They must "trust to luck," however, that this is done, as but seven roads say that they have any system of indicating to other inspectors that the car is defective, and the lack of facilities for test inspection in yards and at terminals would render the chances of its detection very small before it was again placed in train.

In looking over the list of defects the committee found the number of air-brake coupling gaskets replaced to be very large. This was due to the hook of the dummy coupling being inserted inside the gasket. It suggested the enlargement of the dummy coupling as shown in Fig. 3.

Mr. A. M. Waitt moved that the report be received;

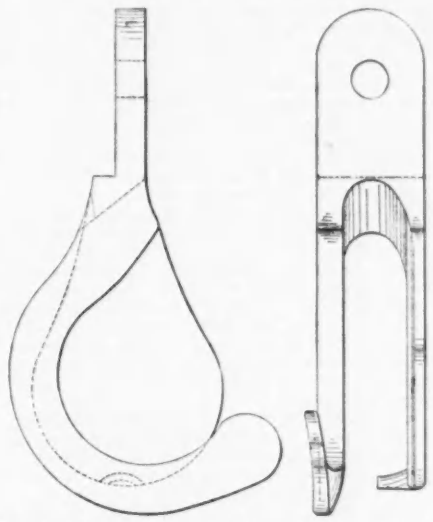


Fig. 3. Proposed Modification of Dummy Coupling Hook for Air Brakes.

that the features in it that the committee recommended be submitted to letter ballot as recommended practice, and the committee be continued another year. The motion was carried.

Compressed Air Appliances and Hydraulic Machinery.

The report of this committee was accompanied by numerous illustrations, and we postpone its presentation to our next issue.

Freight Car Trucks.

The committee was appointed to report on the advisability of adopting standard sizes and shapes for arch bars and channel transoms for diamond trucks, and to recommend sizes and shapes if desirable, and to ascertain the results obtained from trucks of various designs, with special reference to newer form of trucks. As a result of the investigations made it recommended: (1) A 5-ft. wheel base for all trucks, as it would enable the use of standard fulcrums for brakebeams for air-brakes, and standard bottom rods. (2) Standard sizes for arch bars to be: Top 1¼ × 4 ins., bottom 1 × 4 ins., and tie bar ⅝ × 4 ins. It was considered inadvisable to recommend standard designs for arch bars or standard channel transoms.

In opening the discussion on the recommendations Mr. A. E. Mitchell (N. Y., L. E. & Wn.) made a motion that the wheel base be changed to 5 ft. 2 ins., for the reason that with a 5-ft. wheel base it was almost impossible to get the inside hung brakebeam under the car. When the Fox truck was first introduced in this country, the wheel base was 5 ft., and he tried at that time to get in an inside hung beam on that truck, but found it impossible to do so and have the beam any height from the track. The Fox truck people changed the wheel base to 5 ft. 2 ins., and all their designs and dies are on that basis, and consequently all of Fox's trucks—and there are over 9,500 running in this country—are 5 ft. 2 ins. Out of 40,000 cars on the Erie system 80 per cent. have trucks with 5 ft. 2 ins. base.

Mr. G. W. West (N. Y., Ont. & Wn.).—I would indorse Mr. Mitchell's views. We have some Fox pressed steel trucks running very satisfactorily. It has been shown by the committee that there is no standard, and I think we should work toward a standard, certainly so far as the wheel base is concerned.

Mr. J. J. Hennessey (Chic., Mil. & St. P.).—A large majority of the replies to the committee were in favor of 5-ft. wheel base. I watched to see how many of these people recommended 5-ft. wheel base that were using inside hung brake, and I think there were few exceptions that recommended anything larger.

Mr. A. E. Mitchell.—With 5 ft. 2-in. wheel base with the Diamond truck, we have only ¾-in. clearance between the back of the brakebeam and spring plank; 12 ins. wide, channel iron spring plank.

Mr. Mitchell's motion to change the base to 5 ft. 2 ins. was carried.

The reading and discussion of the reports being now completed the convention proceeded to the election of officers for the coming year, after which the final adjournment was taken.

The following officers were elected: President, J. S. Lentz (Lehigh Valley); Vice-President, S. A. Crone (New York Central); Second Vice-President, E. D. Bronner (Mich. Central); Third Vice-President, J. C. Barber (No. Pac.); Treasurer, George W. Demarest (No'n Central); Member of Executive Committee to fill unexpired term of J. C. Barber, Samuel Irvin (Mo., Kan. & Tex.); three members of the Executive Committee, J. T. Chamberlain (Bost. & Me.), G. W. Rhodes (C., B. & Q.), Pulaski Leeds, (Louisville & Nashville).

NEW ENGLAND WATER-WORKS ASSOCIATION.

The thirteenth annual convention of the association was held at the United States Hotel, Boston, June 14 to 16, inclusive. The meeting was called to order by the president, Mr. Geo. E. Batchelder, after which the association was formally welcomed in an address by the Mayor of Boston, Hon. Nathan Matthews, Jr. The Mayor discussed in an interesting manner the financial management of water-works under municipal ownership, stating that of all the so-called natural monopolies, the business of supplying water is the ideal one for municipal ownership. He doubted, however, whether municipal water-works are often self-supporting. Two factors tend to reduce the rates levied by municipal works: first, the demand for low rates to manufacturers to meet low rates charged in other cities; and, secondly, the desire to lower all rates for political purposes. The theory has been that the water users should pay rates high enough to meet the cost of building and operating the works; but often general taxation is relied upon to make up deficiencies. A great evil of municipal undertakings, Mr. Matthews stated, is the capitalization of some of the annual expenditures, such as extensions of distributing mains. The speaker believed that water rates should be made sufficiently high to cover all extensions except for new reservoirs, or other large permanent improvements. In conclusion, Mr. Matthews urged that the association investigate the general financial methods and conditions of water-works owned by municipalities.

The president in his annual address referred to the state meter inspector bill, which was recently introduced in the Massachusetts legislature, but was postponed to the next session. He was opposed to the bill as designed to serve special interests.

The combined report of the secretary and treasurer, presented by Mr. R. C. P. Coggeshall, secretary, showed the following membership on June 1, 1893, and June 1, 1894, with net gain, by classes of membership:

Members.	June 1, 1893.	June 1, 1894.	Net gain.
Active	338	365	27
Honorary	5	5	..
Associate	69	73	4
Total	412	443	31

During the year there were 13 deaths among the members of the association. The total balance in the treasury at the date of the report was $1,963.

After the presentation of the report the reading of papers was begun.

Laying a 12-in. Main Across a Rocky Mill Stream and Over a Dam.

This paper was by Mr. Geo. F. Chace, of Taunton, and described the replacing of 2,421 ft. of 6-in. pipe with 16-in., 236 ft. of which presented some difficulties, as described in the following abstract:

The 236 ft. mentioned above included 60 ft. of pipe originally laid in the rocky bed of Mill River, which required blasting, 30 ft. laid beneath a flume and 136 ft. between the river and flume, the latter passing through a wing dam. Owing to various complications it was considered best to carry the new main over the river, wing dam and flume. The bridges not being suitable to carry the pipe, it was supported on trusses at each crossing. A contract was made with the Taunton Locomotive Manufacturing Co. for a 16-in. flange pipe line across the river, supported by a truss of 1½-in. wrought iron resting on the bridge abutments. Ball and spigot joints and an ordinary iron truss were used for the 30-ft. flume crossing.

The pipe between the two bridges was laid on a stone river wall, after first removing a fence, leveling and pointing the wall. A floor 22 ins. wide, of 2-in. tongued and grooved plank was laid upon the wall. Back of each bell of the bell and spigot pipe here laid was a support cut the shape of the pipe out of 3-in. plank on edge, suspending the pipe about 3 ins. above the wooden floor.

After the joints had been calked, the pipe was boxed up with 2-in. plank, matched and planed, the box being thoroughly packed around the pipe with mineral wool, there being from 2 to 3 ins. space all around for this purpose. The side of the box next to the street was carried up to a height of 5 ft. and formed a fence. Then an incline of 2-in. plank matched and planed was built like the side of a pitch roof about 1 ft. below the top of this fence and projecting a few inches beyond the top of the river side of the box. The space between the horizontal top of the box and this sloping roof was left filled with air.

In discussing Mr. Chace's paper Mr. H. G. Holden inquired why an expansion joint was not used, and stated that in laying 700 ft. of pipe at Nashua he had used two expansion joints and found that the contrac-

tion at zero temperature was between 6 and 7 ins. Mr. Chace replied that he considered an expansion joint unnecessary on so short a length of pipe and wished to avoid expense.

The Water Service and Fire Protection of Theaters.

Mr. Wm. Paul Gerhard, of New York city, sent in a paper treating this subject in great detail. Extracts from the paper, which cover over 50 typewritten pages, were read by the secretary. Some of the most interesting parts of the paper were as follows:*

The complete fire protection of theaters requires: (1) Outside fire hydrants; (2) inside stand-pipes with fire valves, hose and nozzles, supplied from direct street pressure or from (3) fire tanks or (4) fire pumps; (5) an automatic sprinkler system, with elevated water tank and outside or fire department connection; (6) a system of perforated pipes on the stage over the proscenium opening; (7) firepails and casks of water; (8) chemical or portable fire extinguishers; (9) a series of wet sponges on long poles; (10) wet woolen blankets, asbestos sheets and asbestos gloves; (11) steam nozzles or jets; (12) fire axes, fire hooks and knives.

Street mains drawn from for theater supplies should be at least 8 ins. in diameter, and frost-proof post fire hydrants are preferable.

Where fire pumps are used it seems unnecessary and objectionable that the supply in case of emergency should be drawn through a meter, to avoid which a by-pass controlled by a gate valve sealed by the water department could be used. While such by-passes are allowed in France and Germany, I was unable to convince the authorities of New York city that such a device was desirable.

For fire pumps the underwriter pattern is without doubt the best of the direct-acting type. For small theaters I would recommend as the minimum a two-stream pump with a capacity of 500 gallons per minute; for medium-sized theaters a four-stream, discharging 1,000 gallons per minute; for large theaters, either a six or, better, two four-stream pumps, giving total capacities of 1,500 and 2,000 gallons per minute.

Ordinarily the fire pump should draw water from a tank rather than directly from the main, which tank should be made as large as space will permit in order to provide a reserve supply.

Stand-pipe and fire valves should be provided as needed, the former ranging from 2 to 3 ins. in diameter, with 2½ ins. as a desirable minimum, and the latter from 1½ to 2½ ins., the latter being required in some cities having building laws.

For automatic sprinklers the three principal systems are: (1) The ordinary wet pipe, which is in most general use, but is liable to freezing and, in some cases, to the bursting of sprinkler heads, in either event damage from water being likely to result. (2) The non-freezing, wet-pipe system, where the pipes are filled with a non-freezing and non-corrosive liquid, replaced by water when put in use; this system is open to the possible objections of leakage and corrosion of sprinkler heads. (3) The dry-pipe system, designed for buildings liable to freezing; the pipes are kept filled with compressed air until automatically put in operation. This system requires especial care to prevent air leakage.

The supply mains for the automatic sprinklers should have a capacity of at least 50% of all sprinklers fed in the largest space enclosed by fire walls and a larger percentage in some cases. No pipe smaller than ¾ in. should be used and only one sprinkler should be fed from this size of pipe, provided the feed pipe is not longer than 30 ft.

Finally, the fire service system should be entirely separate from the general water supply of the theater.

Thursday Afternoon.

A letter from Mr. J. J. R. Croes was read stating his inability to present at this meeting his paper on underground water supply and asking the members to give him facts bearing on the decrease in such supply systems after being drawn upon for a considerable time. Mr. Croes is disposed to assume that any supply of water obtainable from subterranean strata is very limited in extent and liable to constant diminution.

Flow of Water in a 36 and 30-in. Compound Pipe.

A volunteer paper on the above subject by Mr. Geo. A. Ellis was read by the secretary. It related to a paper by Mr. L. M. Hastings published in the June number of the Journal of the association, in which Mr. Hastings seemed to conclude that the pipe in question acted like a sealed pipe. Mr. Ellis believed this conclusion was wrong and presented arguments in proof of his opinion.

Destructive Action of Electric Currents on Water Pipe.

The above paper was contributed by Messrs. Chas. A. Stone and Howard C. Forbes and read by the latter. So much attention has lately been given to electrolytic action that premature corrosion of water pipes from any cause is likely to be attributed to electricity. Ordinary rusting does not take place at a uniform rate, varying, for instance, with the character of the soil, but often natural corrosion is hastened by the action of electric currents.

Experiments are now being made by the authors, at the request of Mr. Wm. Jackson, M. Am. Soc. C. E., City Engineer of Boston, to find a method of distinguishing between electrolytic and natural corrosion.

The various methods proposed to prevent electrolysis may be classed under three heads as follows: (1) Complete remedies, such as the double trolley and storage battery systems, complete insulation of the pipes and possibly the alternating system. For the present the first three systems are considered as in themselves impracticable, and it is yet too early to pronounce upon the latter. (2) Partial remedies, such as very heavy return wires from the tracks to the power station, with good bonds between the rails; also returns from sections of track every 500 ft. along the route; but this can never entirely do away with the difficulty; the three-wire system, regarding which little is actually known and which is not as yet promising; insulation of tracks, which, as indicated, only tends to reduce the injury. (3) Schemes which are useless, as connections from the tracks to the pipes, bringing the pipes to uniform potential and reversing the current at frequent intervals.

In addition to the above methods the connection of the pipes to the negative plate at the power station has been tried several times and with beneficial results. The problem here is to get the current through the joints in the pipe without injuring the latter.

At the opening of the discussion of the paper on electrolysis Mr. I. H. Farnham was called upon. He described a simple method of testing for corrosion by electricity, consisting of placing two short pieces of pipe near a pipe in the distributing system at the suspected point and connecting one of the pieces with the main pipe. If corrosion was afterward shown in the connected pipe but not in the unconnected the conclusion is obvious. If pipes could be made to carry current without a change in the resistance caused by poor joints, etc., it would be possible by making proper connections with the water mains near the power station to prevent corrosion.

In most cities, Mr. Farnham stated, the trolley wire is positive and the danger district is then near the power station and the current can be conducted to the station by wiring. With a negative trolley wire the danger district would be at the extreme end of the railway. Copper bands can be used to diminish the resistance at poor joints.

Mr. Geo. E. Winslow thought that the storage battery system was less likely to give trouble than the double trolley.

Mr. Sparks said that in 1890 a 12-in. main was laid from a pumping station at Veazie, Me., across the river to Brewer. Water and electric railway plants were run by the same company and the return was made by connecting with hydrants. After a few months of use the submerged main broke in 35 ft. of water. It was repaired, but broke again after a few months, and later still again. The broken pipe was so badly decayed that a ring nearly around it could easily be broken out with a hammer. A new main was laid and about the same time seven strands of No. 6 copper wire were carried beneath the river and connected with the pipe at each end. Since this was done there has been no trouble.

A Portable Platform to Aid in Excavating Trenches.

A volunteer paper by Mr. R. C. P. Coggeshall described a device to keep a business street as clear as possible during trenching.

A platform was made consisting of ⅞-in. spruce boards secured to 3 × 4-in. spruce joists. The platform was in two sections, each 6 × 12 ft., hinged so that one had a horizontal and the other a vertical position, portable braces being used. In shifting from place to place, the platform could be folded up and moved easily. The laborers showed more care in throwing up the dirt, so it did not need rehandling; it was not necessary to trim the outer slope to keep the passage clear and in backfilling a part of the earth could be dumped in by lifting the platform trench. By experiment with two 300-ft. lengths of trench 4 ft. 10 ins. deep, for 8-in. pipe, it was found that the cost of trenching with the platform, including cartage, was 14.7 cts., and without, 19.3 cts. per lin. ft., or a saving of 24%.

Thursday Evening.

The Lawrence Filter and Its Results.

A description, illustrated by lantern slides, of the construction and operation of the intermittent sand filter put in operation Sept. 20, 1894, by the city of Lawrence was read by Mr. Hiram F. Mills. As this filter was fully described and illustrated in our issue of Aug. 3, 1893, little need be said about it here except to give the results and to state that the paper was very complete and valuable and affords an opportunity to judge of the practicable value of the experimental work of the Massachusetts State Board of Health, the filter being designed in accordance with deductions from the experiments and studies of the board and of Mr. Mills, who is a member of the board.

The bacteriological results from the filter are of chief interest, since it was built to lessen or remove danger from typhoid fever long highly prevalent in Lawrence through use of the polluted Merrimac River water. In the first three weeks of use the bacteria coming through the filter were reduced from 75 to 2% of the number applied, and from that time until the present has averaged only 1.7%, except twice, when work on the filter or pump well interfered with filtration. The removal of food material from the water (and deposition in the reservoir, probably) decreases the number of bacteria still further, before it reaches consumers, while it is believed that most or all of the remaining bacteria are harmless.

Since the filter has been in operation the number of deaths from typhoid fever has been reduced to 40% of the mortality from that disease for the corresponding eight previous months, while nearly half of the deaths from typhoid since the filter was put in operation were of people who used polluted canal and not purified river water.

Experiments with Tube Wells at Lowell, Mass.

This paper was read by Mr. Geo. Bowers, City Engineer of Lowell, and details experiments begun in August, 1891, and continuing until the construction of a permanent plant was begun in April, 1893, work on which has not yet been completed, the plant now indicating a daily yield of 3,300,000 gallons against a guaranteed supply of 5,000,000, which, according to the contract must eventually be secured.

Unsatisfactory experiments were made by two contractors, whose methods and results are fully detailed in the paper, after which arrangements were made with Mr. Wm. D. Andrews, of New York city, to continue the experiments at the city's expense, using his own devices and receiving pay by the day. Three experiments were made under this arrangement along the Merrimac River, after which a site was tried which proved successful, 1¾ miles south of the Merrimac and one mile west of the Concord River, in the valley of Beaver Meadow Brook. The land drained by this brook has an area of about 22 sq. miles and consists largely of sand and gravel. Here Mr. Andrews sank 16 wells the results from which seemed to warrant the preparation of specifications and obtaining of bids for a 5,000,000-gallon plant.

The specifications provided that the city would furnish the land and the contractor construct the wells and connect them with a receiver built by him, and make all temporary tests at the direction of the city engineer.

The proposed terms of payment were as follows: After sufficient wells had been constructed and subjected to test to warrant the city engineer in believing that 5,000,000 gallons per day had been secured, the city was to pay the contractor 25% of the contract price. After the wells had been connected and upon test by the city for 30 days found to yield the contract amount, 25% additional was to be paid and a like payment after a three-months' test with like results. The final 25% was to be paid after a year's pumping with a full yield of 5,000,000 gallons per day.

Proposals on the above basis were received from five bidders, the bids ranging from $8,500 to $4,850 per million gallons, the latter offer being from the Cook Well Co., of St. Louis, to whom the contract was awarded.

The company sank 17 test wells before locating the permanent plant, which latter was accomplished April 22. The formation was so irregular that one well might be good and the next so poor as to require pulling up the pipe. The wells vary in depth from 47 to 67 ft., the average being 52 ft., and all being 6 ins. in diameter. Before the wells were connected and pumped by steam the elevation of the water in each was 9 ins. above that in the brook and rose and fell with the latter, the water from the wells always flowing into the brook.

The yield from 44 wells when pumped singly being at the rate of 7,000,000 gallons per day a test of the wells collectively was ordered and on Sept. 16 the supply was found to be 2,000,000 gallons. It becoming evident that the wells were too near together experiments were made to determine which could be cut out without affecting the quality of the water obtained. Finally 12 wells were removed, leaving 32, from which 2,333,000 gallons have been pumped in 24 hours. After adding 18 wells 3,000,000 gallons per day were pumped for some time, then alterations were made in the pumping machinery and 22 4-in. wells added, making 72 in all, from which 3,300,000 gallons per day are now being pumped, with a vacuum of 23 to 23½ ins.

The water in the outside test wells now shows conclusively that the supply is greater than the draft.

The method of sinking the wells used by the Cook Co.

* All the papers read at this meeting, with the discussion, will be published in the "Journal of the New England Water-Works Association."

is very different from that employed in the former experiments. The pipe is put down by the use of a sand bucket nearly as large as the interior of the pipe and about 6 ft. long. The bucket is raised and lowered by wooden rods connected together at the ends, so that when in the well they act as one rod and make the bucket very efficient in its work. This bucket removes all the material from the inside of the pipe, and when it is sunk in gravel, stones 5½ ins. in diameter have been removed with it. While the earth is being removed, the pipe is gently turned or rocked and goes down by its own weight. This is a very rapid manner of getting pipe down through quicksand. In very hard gravel the pipe is sometimes driven a little with a heavy wooden weight. If stones too large to come up through the pipe are encountered, they are broken with a large drill, or, if this is impossible, the pipe is pulled up and the location changed.

Two push wells, so called, were put down in the spring. These wells are constructed by building a strong dam to press against and using a very strong clamp on the pipe. The pipe is pushed into the ground by the use of four jack screws. This is a very slow and expensive way, but allows a very long screen to be placed in a narrow stratum of water-bearing material, and has worked very well at other places, but here the material is not uniform enough to warrant the outlay. They are both good wells, but not enough better than the others to pay the difference in the cost.

All the wells are made with the Cook patent strainer, varying in length from 8 to 17 ft., according to the depth of the water-bearing stratum. The screens in the push wells are one 24 and the other 42 ft. in length.

After the screens are swedged into the well pipe and the well thoroughly pumped and washed by steam, the water is perfectly clear and no sand comes up through the screen. The screens being made from a drawn brass tube, there is no chance for rust or corrosion, and to all appearances they are very durable, and they certainly are very fine specimens of mechanical skill.

Friday Morning.

At the opening of the session it was decided to hold the next annual meeting at Burlington, Vt.

Care of Water Meters.

A discussion on this question was opened by Mr. J. C. Whitney, Water Registrar, Newton, Mass. The care of a meter begins when it is received from the factory, when Mr. Whitney suggested that it be put to a test with large and small streams. In case of a ⅝-in. meter it was suggested that it first be tested by running 5 ft. through it at the rate stated by the maker to be its greatest proper quantity. Variation from absolute accuracy on this test should not exceed 2%. For small streams a rate of 1.2 ft. per hour was named, the meter being expected to indicate at least 80% of the flow. Time can be saved in this test by running several meters at once. These tests are to be recorded for future reference. The permanent meter record should include frequency and cost of repairs.

A special examination of each meter should be made at least once in two years. The examiner may be provided with a four-gallon pail and two brass caps, one having a 1-20 and the other a ¼-in. orifice. The meter is read and the ¼-in. cap attached to the faucet and 7½ gallons drawn. The meter is again read and discrepancy noted. Next the 1-20-in. cap is attached to the faucet, water turned on and the meter watched. If the meter does not start within a minute the meter is removed for repairs as soon after as convenient. If the meter starts promptly about 1¼ gallons is drawn, which on a maximum pressure requires about three minutes.

A gentleman from Europe was next called on, who stated that he believed meters were better cared for on the other side of the water than here. Meters there are owned by the water-works department and they are often changed about, examined and repaired if necessary.

Mr. Peter Milne said he believed meters should be a part of the water-works plant, as their legal status was then more certain, and examination and repair could be made with less friction.

What a Water Supply Engineer Can Do in the Fire Department.

An instructive paper with the above title was read by Mr. Jas. E. Tryon, of Detroit, Mich. Mr. Tryon stated that so far as his knowledge goes Detroit is the only city in the United States where the fire department is charged with the duty of providing fire hydrants and fire reservoirs, the department having assumed this charge some 20 years ago. The first triumphs achieved under the new management were: (1) The taking out of all 3-in. hydrant branches. (2) the removal of all hydrants with 2½-in. openings. (3) the drainage of all hydrants to prevent freezing. At present over 95% of the hydrants drain to the sewer and the exceptions are due to lack of sewers to drain into.

Mr. Tryon stated that hydrants at dead ends are of no use for fire streams, but that in Detroit 7,000-gallon tubs or cisterns are fed from such hydrants with good results. The city has 500 reservoirs of various sizes with a total storage capacity of 4,000,000 gallons. Some of the downtown reservoirs are sewer-shaped and have capacities of 20,000 gallons. Fire hydrants in Detroit are "considered sacred, and street sprinklers, sewer diggers and others" are obliged to get their water elsewhere.

Six lines of street mains have been laid in Detroit under the direction of Mr. Tryon for the purpose of making the fireboat available for fires at least half a mile from the river.

There are three long lines of 2,000 ft. each and three short lines of 1,000 ft. each, or 9,000 ft. in all. The pipe is of 8-in. steel, such as the Standard Oil Co. uses for piping crude oil. The pipe is subjected to a test of 1,000 lbs. hydraulic pressure. Connection at the river is made with a three or a five-way Siamese with 3½-in. openings, with a clack valve over each to enable the boat to start its pumps as soon as the first connection is made. Hydrants having two 3-in. and one 4-in. opening are set at intervals along the line with a manhole opposite each. At the end of the pipe is an air valve loaded to remain open until the water comes, and a relief valve set at 250 lbs.

The falling of inclosing walls early in a fire at which one of these fire pipe lines was being used suggested the question what would be done with the pipe line in the event of the demolition of a hydrant. There was but one course open and that was to shut down the pumps, dig away the debris and plug the broken pipe. This would take time. This problem had not suggested itself when the line was planned. The solution was reached by providing for a dividing gate by which the hydrant or the main could be shut off. One of these was placed in every manhole except the upper one, so that in the event of a break it is possible to shut off a section of the pipe line without any stoppage at the boat.

These lines were fully completed during the summer of 1893 and were filled repeatedly during the past winter. We have had but two incidents to mar the successful working of the lines, one being the failure of the air valve to work, owing to the insufficient load which made it impossible to fill the pipe and the other was due to the failure of a relief valve to work, having been set at 400 lbs. The damage in this case was the blowing off of the Siamese. The pipes are laid as nearly on a level as possible, the rise being about 8½ ft. in a thousand. The grade is toward the river and to prevent the freezing of the dead water, the pipes are emptied after each filling. When the boat responds to an alarm of fire connection is made with the most available pipe line and the pumps started, just as a land engine fills its line of hose. When the pipe is filled the pumps are stopped to await orders. A single wire laid in a pipe in the same trench with the pipe line is run into the engine room and a signal code is used, by means of a push button, which can be operated at any hydrant on the line.

We have worked through 1,000 ft. of 3-in. hose stretched from a hydrant 2,000 ft. from the river, with a pressure of 165 lbs. at the hydrant and 175 lbs. at the boat. The friction loss in a line 2,000 ft. long working through two 100-ft. lines of 3-in. hose with 1¾-in. nozzles is as follows:

Pressure at boat, lbs.	Pressure at hydrant, lbs.	Loss, lbs. per ft.
120	80	.0200
140	90	.0250
160	105	.0275
180	120	.0300

Friday Evening.

At the opening of the session Mr. Geo. A. Stacy, Superintendent of the city water-works of Marlboro, Mass., was elected President of the Association, and Geo. E. Batcheider, Treasurer. Mr. R. C. P. Coggeshall was re-elected as Secretary, Mr. Dexter Brackett, M. Am. Soc. C. E., as Senior Editor, and Mr. Walter H. Richards, as Junior Editor. It was decided to hold the fall meeting somewhere in the White Mountains in September. The closing paper was by Mr. E. D. Leavitt, M. Am. Soc. M. E., and was entitled

A Few Examples of High Grade Pumping Service.

Mr. Leavitt's remarks were accompanied with lantern slides. He first spoke of the advantages of pumps designed especially for the work they are to perform, and said that though not popular they are the cheapest in the long run. A large part of the paper was an account of the evolution of the class of pumping engines designed by Mr. Leavitt, beginning in 1874 with the Erie, built for the Calumet & Hecla Mining Co. The Erie was designed to run 144 hours per week. It was intended for a capacity of 4,000 gallons per minute, or 5,800,000 gallons per day, but the demands upon it ran it up to about 11,000,000 gallons per day, the revolutions per minute increasing from 19 to 35. In a similar way the Ontario, built for the same company in 1876, was designed for about 14,400,000 gallons per day at 30 revs. per minute, but has been run at 20,000,000 with 37½ revs. per minute. The foundations for this pump were of local sandstone and have suffered a partial disintegration.

A change in the location of an engine built by Mr. Leavitt required the substitution of a 75-ft. suction pipe in place of locating the pump in a wet well. The results since the change have been so good that Mr. Leavitt now prefers a suction to a wet well.

An engine designed by Mr. Leavitt for the water-works of Louisville, Ky., has recently been tested by Messrs. F. W. Dean, M. Am. Soc. M. E., and Dexter Brackett, M. Am. Soc. C. E. A six-days' continuous test showed a duty of 129,950,000 ft.-lbs. per 100 lbs. of coal, or 151,000,000 per 1,000 lbs. of steam. The engine has a capacity of 16,000,000 gallons and works against a head of about 190 ft. A plunger card from this pump was shown on which the pencil went over the same line 17 times.

The high class of the work done on the Leavitt engines was stated to be the explanation of their great cost. Mr. Leavitt thought the pumping engine of the future would be smaller or lighter, for the same capacity, than that of the present.

An interesting opinion expressed by Mr. Leavitt was that the extra expense entailed by building an engine with bright parts paid for itself in the long run. The Erie engine was originally built black, but later was finished bright, after which much better care was taken of it. Mr. Leavitt also expressed himself as in favor, of late, of a single rather than a three-crank engine, and as believing that pumping engine tests are carried out with too great refinement in many instances. Water-works officials, he stated, are chiefly interested in the coal pile at one end and the reservoir at the other. Long tests were advised.

The only discussion of Mr. Leavitt's paper was by Mr. F. W. Dean, who was called upon. Mr. Dean stated that the new pumps at St. Louis will have a 30-days' continuous test. He believed the Louisville test of 144 hours without stopping, was the longest on record. The Louisville engine used 12.17 lbs. of dry steam per I. H.P., the steam containing only 0.5% of moisture. Mr. Dean thought the internally fired boiler gives 10% better results than the externally fired. He defended, somewhat, the modern nicety of tests of which Mr. Leavitt had spoken disparagingly.

Before final adjournment the newly elected president, Mr. Geo. A. Stacy, made a few remarks in which he stated that he believed the past success of the association had been largely due to the fact that it had given its honors to the superintendents from the smaller places as well as to men from the large cities.

The Excursions.

On Thursday a long drive was taken and visits were made to the Newton and Brookline pumping stations and to the Chestnut Hill reservoir and pumping station of the Boston water-works.

On Saturday, by the courtesy of the city of Boston, a sail through the harbor was taken, stopping, among other places, at the pumping station of the Boston main sewerage system. A lunch was served on board the steamer.

During the convention 32 new members were elected, bringing the total membership, of all classes, up to 475.

COMING TECHNICAL MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
June 20, 25. Annual meeting at Niagara Falls. Secy., F. Collingwood, 127 E. 23d St., New York.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
July 3. Secy., F. C. Osborn, Case Library Building.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
July 6. Secy., E. K. Smoot, 803 Commerce St.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
July 6. Secy., O. Von Geldern, 719 Market St., San Francisco.

NORTHWEST RAILWAY CLUB.
July 10. Secy., W. D. Crosman, Ryan Hotel, St. Paul.

DENVER SOCIETY OF CIVIL ENGINEERS.
July 10. Secy., F. E. King, Jacobson Block.

NORTHWESTERN SOCIETY OF ENGINEERS.
July 10. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.

WESTERN SOCIETY OF ENGINEERS.
July 11. Secy., Thos. Appleton, Lakeside Bldg., Chicago.

ENGINEERING ASSOCIATION OF THE SOUTH.
July 12. Secy., Hunter McDonald, Nashville, Tenn.

ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
July 12. Secy., G. W. Shaw, Norton Building.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
July 12. Secy., C. H. McLeod, Montreal, P. Q.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
July 14. Alleghany Springs, Va. Secy., J. A. Pilcher, Roanoke, Va.

MONTANA SOCIETY OF CIVIL ENGINEERS.
July 14. Secy., G. O. Foss, Helena.

ENGINEERS' CLUB OF KANSAS CITY.
July 16. Secy., Waterman Stone, Baird Building.

WISCONSIN POLYTECHNIC SOCIETY.
July 16. Secy., M. F. Schinke, City Hall, Milwaukee.

ENGINEERS' CLUB OF MINNEAPOLIS.
July 16. Secy., E. Nexsen, 504 Kasota Block.

COLUMBIAN ENGINEERING SOCIETY.
July 17. Secy., F. W. Hart, Washington, D. C.

BOSTON SOCIETY OF CIVIL ENGINEERS.
July 18. Secy., S. E. Tinkham, 36 Bromfield St.

ENGINEERS' CLUB OF CINCINNATI.
July 19. Secy., J. F. Wilson, 24 W. 4th St.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
July 19. Secy., Howard Berge, 100 Washington St.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
July 19. Secy., Daniel Carhart, Carnegie Lib. Bldg., Allegheny.

TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
July 20. 201 Washington Building.

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AND

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We give considerable space in this issue to the expert report on the relative merits of different asphalts, prepared for the Citizens' Municipal Association of Philadelphia. The statements made in the report are so sweeping and raise questions of such importance, that we have given space also to a criticism of the report by two of the most prominent experts in asphalt, which makes the whole an exceedingly interesting and valuable symposium on the asphalt question. On the matter of the relative merits of the different asphalts, we leave our readers to form their own conclusions, but there are some facts which may help to an understanding of the situation in Philadelphia. In the first place, there seems to be no doubt that the city's asphalt pavements are not giving the results which they should. In the second place, one excellent reason for this is the foundation on which some of the asphalt has been laid. "Bituminous concrete" is the Philadelphia name, so we are informed, for a layer of broken stone over which coal-tar is poured till the interstices are filled. We understand that asphalt in Philadelphia has been laid over a 4-in. layer of this material. Engineers will generally agree that it is a penny-wise and pound-foolish policy to substitute such a material for good concrete.

Further than this, we have recently noted in these columns the fact that the paving contractors in Philadelphia object to having the asphalt sprinkled, and we have also given authentic instances of loaded wagons being stuck in the asphalt when warmed by the sun. We risk nothing in saying that a good asphalt pavement will stand street sprinkling without injury, and will certainly never stick to a vehicle wheel. Whether the cause of the stickiness was the use of too soft a mixture of the asphalt or the introduction of coal tar into the mixture, we cannot say; but the fact that such things have occurred in Philadelphia should not be set down against good and properly laid asphalt as a paving material.

Boston seems destined to be saddled with the Meigs elevated railway system, if the Massachusetts legislature has its way. The House on June 13 passed the bill granting a franchise to the promoters of the Meigs system for the construction of an extensive system of elevated railways in Boston and its suburbs. The bill has still to run the gauntlet of the Senate, and to receive the Governor's approval, and even if successful in this it will then be a question whether Captain Meigs will be able to secure the necessary capital for the construction of the road. Why this system should at this day be resurrected as the desideratum for rapid transit in Boston, is well-nigh inexplicable. The main idea of the Meigs system is to have the cars straddle a central girder to prevent them from falling off the structure in case of derailment. This principle was developed back in the '70's, and some of our readers may remember an early example of it, the "single-rail" railway exhibited at Philadelphia in 1876. At that time the bugbear with respect to elevated railways was that every derailment would cause a frightful accident. The large experience which has been had with elevated railways since their use became general, however, has shown that the system of wooden guard rails is an entire protection in case of derailment, and that the "saddle-bag" principle, on which many of the early inventors laid so much stress, is wholly needless.

With this fact in mind, it is difficult to understand how Captain Meigs has been able to secure among the Massachusetts legislators so many firm believers in his system as the best possible for erection in Boston streets. It is true the merits and advantages which he claims for it are legion; and he has all manner of innovations and "gimcracks" tacked onto it; but so far as we are aware there is no claim made for this system which might not be realized with an ordinary elevated railway system. If any of our readers desire to form an opinion for themselves concerning the system, we advise a careful perusal of the pamphlet published by its inventor, which we presume any engineer can obtain on request by addressing the Meigs Elevated Ry. Construction Co., East Boston, Mass.

Generosity to inventors has never been recorded as a prominent characteristic of large corporations. For this reason when, a few months ago, the Metropolitan Traction Co. announced that the munificent sum of $50,000 was in its treasury awaiting the fortunate inventor who should submit a practicable scheme for electric traction without overhead wires, every one was astonished. The generosity of the corporation appeared to be without bounds. Not only did they offer this great prize, but they did it in a manner which appeared to be most liberal. The fortunate inventor could charge them, in addition to the prize, a reasonable royalty for the use of his system, and would have, moreover, the enormously valuable prestige in going on the market with his device of having come off victor in so noted a competition. It was no wonder that under these circumstances some thousand and odd inventors and engineers put on their thinking caps, and every man of the many who had been working on the problem before the announcement of the offer redoubled his energies.

The New York Railroad Commission was to award the prize—so the offer ran—and the first thing to do was to get a bill through the legislature authorizing the commission to undertake this unusual task. This was done after much delay, during which an enormous mass of plans and proposals had been sent in, both to the Traction Co. and to the Railroad Commission. The latter body was just getting in shape to take up the work of sifting the wheat from the chaff, when it received from the Traction Co. a formal withdrawal of the offer, the excuse given being that so much delay had occurred that the company had taken the work of examination in its own hands. According to latest rumor, the General Electric Co. is to equip an experimental section of conduit road for the Traction Co., the Siemens-Halske Co., which had the "inside track" at first, having withdrawn when the Traction Co. stipulated that it was to be protected from all suits for patent infringement.

The state of mind of the multitude of inventors who have been induced to spend time and money in working on the problem, by the offer of the Traction Co., can be imagined. It is true the inventor of a successful system of conduit electric road should reap handsome returns apart from any such offer; but the practical aspect of the case is that so many men have been set working on the problem by the Traction Company's offer, that they are all treading on one another's toes. Great minds run in the same channel; and when a number of able men simultaneously attack such a problem, a number of claimants for priority in each special feature are sure to arise. The result is that no one inventor can gain such broad claims from the patent office as will induce capitalists to take up his invention and the actual result may be to retard progress in the art rather than to accelerate it.

It seems possible that the company cannot withdraw its offer without becoming liable for damages to inventors who have been induced to expend time and money by the company's offer; but few inventors have funds to spare to start a suit at law against such a powerful corporation as the Metropolitan Traction Co. It would be of no small value, however, to have the legal responsibility involved in the public offer of prises or rewards settled by the courts. Perhaps the hundred and odd architects who contributed competitive plans for New York's new City Hall, and now find that there is little chance of the building being constructed for years to come, would be willing to contribute something toward a judicial decision of this question.

There has been a constantly increasing tendency observable among railway companies in the last few years to add to the number of items for which the owners of cars are chargeable by companies compelled to make repairs on such cars received in interchange traffic. To those who have watched this movement it has often seemed that the time would ultimately come when all car repairs made by foreign roads would be charged to the home company. At each succeeding convention of the Master Car Builders' Association the number of items of car repairs chargeable to the owners has been added to until now the rules of interchange contain a formidable list of such items compared to what they presented a few years ago. The convention held at Saratoga, N. Y., last week was no exception to these, a number of new items being added to the list. The action which showed best the feelings of the members in this direction was, however, the very strong vote polled in favor of the motion of Mr. J. N. Barr, of the Chicago, Milwaukee & St. Paul Ry., to add drawbars and couplers, drawbar timbers and springs, and sills cracked over the transoms to the list. Mr. Barr claimed that the effect of this would be to facilitate the interchange of cars and lessen delays. No one will dispute that this is a most desirable end to attain. The rapid transfer of freight from one part of the country to another great distances apart is demanded and expected by shippers to-day to an extent which was hardly dreamed of a decade ago, and any change of system which will further facilitate this is of great importance. It may be thought at first that the proposed change would have no influence in facilitating freight movement: but on closer consideration it is seen that its general tendency is to simplify the complicated work of inspection at interchange points. A car is easily and quickly inspected to determine whether it is safe to run. It is a much more difficult matter to make sure that every part is in good condition, and that no defects exist for which the road delivering the car should be held responsible. Now if all defects were chargeable to car owners, inspection would become a very simple matter; the complicated defect card system, which is at present a necessary evil, would be no longer required; the constant disputes as to whether a defect is old or new, and the difficulty in securing uniform inspection at the multitude of interchange points, would all be eliminated.

But notwithstanding all these facts, such a change is not at all likely to be made for a good while to come, since it would be contrary to the interests of those roads owning the largest numbers of cars and which have therefore the largest number of votes in the M. C. B. Association. Such a change, it is readily seen, is in effect a reduction

in the rental which the car owners receive for the use of their cars on foreign roads; and unless such a revolution in the present interchange system was accompanied by an agreement to increase the mileage rate for the use of cars or the adoption of some of the proposed combined mileage and per diem systems, with the effect of increasing the revenue from cars on foreign roads, the car owners would, of course, strongly oppose it.

It will be probably conceded, moreover, that they would be fully justified in such opposition. It is true that the private line cars, which are kept constantly on the move, do earn a high percentage on their cost for their owners; this is a leak in railway revenues which has often been pointed out and condemned. The ordinary freight car, however, makes no such heavy mileage as the line car. Its owner has to take the chances of good years and bad years alike, and if in the grain shipping season it is kept constantly on the move, during other months of the year it may stand idle on a side track. It is doubtful, therefore, whether the present mileage rate gives the railways which are heavy owners of equipment more than a fair return on their investment; and if they were to be asked to assume the entire charge for maintenance of their cars, the rate of rental should be increased.

JET PROPULSION FOR STEAMERS.

We show on an inset sheet this week, and describe elsewhere in this issue, a German river steamer of considerable size equipped for jet or hydraulic propulsion. We give space to this as being one of the largest and most important applications of this method of vessel propulsion which has been attempted in recent years, and it is fair to say also, one of the most successful, if the account translated from our German contemporary can be relied on.

The scheme of propelling vessels by a jet of water discharged at the stern has been a favorite with inventors from the very earliest application of steam to the propulsion of vessels, and the experiments with it have been numerous. Even at this day the number of believers in jet propulsion as the ideal system is very large.

While the principles which govern vessel propulsion are comparatively simple and have been at various times clearly laid down, there is a vast amount of misconception prevalent concerning them, and even among engineers the problem is not as generally understood as it should be. An explanation of a somewhat elementary nature therefore, may be of value.

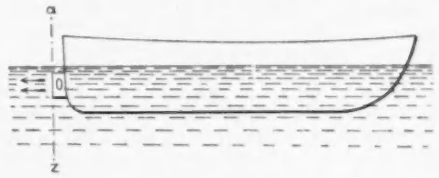
In the first place, it should be plainly understood that, broadly speaking, all methods of propulsion of vessels, both large and small (except only propulsion by sails), are alike in this that the boat or steamer is pushed forward through the water by the action of oars, paddle wheel or screw in pushing a current of water astern. A sailing vessel derives its motion from the push of the wind against its spread canvas; but all other vessels are pushed forward only by pushing water backwards in some manner or other. In jet propulsion, a current of water is sent astern, and a current of water is likewise set flowing backward by every paddle-wheel and every screw propeller that turns, and even by every oar and paddle that is used to propel small boats.

Bearing this in mind, let us go a step further and inquire what general law governs the efficiency of all these systems of propulsion. Let us disregard entirely for the present the mechanism which sets this backward current in motion and consider only the fact that such a current is forced backward and that the opposite force or reaction caused by the force exerted to push this current propels the boat forward. It will be evident in the first place that of the total power exerted by the engines of the vessel part goes to force the ship through the water, to do useful work, and the rest is expended in two ways, as follows: (1) In friction of machinery and of the water in getting under motion toward the rear, and (2) in giving a certain energy to the issuing current of water. Let us disregard for the present the friction loss, and consider only the energy in the current of water which the screw, paddle wheel, or propelling jet sends backward. It is evident that all the energy in this backward flowing current is lost. The mill can no more grind with the water that is past than the steam vessel can get back any energy out of the water which its own engines have set flowing astern. This loss of energy in the issuing water, moreover, is something which is peculiar to the propulsion of vessels. In the propulsion of vehicles on land no such principle is involved. The locomotive, for example, has an absolute hold on the rail, and its sole loss is the loss by friction. The loss in the current sent backward in steamship propulsion may be likened to the loss which would occur if a locomotive were to run over rails which rested on frictionless rollers, so that the inertia of the rails alone resisted the backward push of the driver. Clearly a part of the locomotive's force would then be spent in starting the rails moving backward, and there would be just so much less available to force the locomotive ahead.

Admitting, then, that all the energy of the backward current from the screw, jet or paddle wheel is lost, it is clear that it is desirable to make this loss as small as possible, and this is true whatever the propelling mechanism. The claim was made some years ago by an inventor in New York city, of whose scheme we have something further to say below, that the way to make this loss as small as possible was to make the backward current as small in section and as great in velocity as possible.

Of course it looks plausible enough to the lay mind, that a very small stream of water should carry away less energy than a very large one (as indeed it does, provided the velocities of the two are the same). There are cases, however, where arithmetic is a great aid to correct reasoning. This is one of them. Instead of using arithmetic, however, we will use some very elementary algebra.

In the accompanying sketch suppose the vessel by some means or other—pumps, turbines, screw, paddle, or what not—sets a stream of water flowing backward through the short outlet O. Now consider the conditions in the vertical plane a z



through the mouth of this outlet. The water there is moving with a certain velocity with reference to the surrounding water which we will call v. Also let the area of the cross-section of the issuing stream cut by the plane a z = A. Then by the familiar formula for energy ($E. = \frac{W v^2}{2g}$) we have the energy resident in the water equals its volume $\times$ its weight per unit volume $\times \frac{v^2}{2g}$.

But the volume discharged in a unit of time equals the area of cross-section $\times$ the velocity of the stream with reference to the moving vessel, and calling this velocity p, we have

$$E = (A\ p)\ (\text{weight of water per unit volume})\frac{v^2}{2g}.$$

But p, the velocity of the current with reference to the vessel, = v, the velocity of the current with reference to the surrounding water + s, the velocity of the ship through the water. Also if A and v are expressed in feet we can insert the weight of water per cubic foot and the value of 2 g, and the formula will then stand.

$$E = A\ v^2\ (v + s)\ \frac{62.5}{64.4}$$

Put this in words and it means simply this: That the energy lost in the current which is sent backward from a ship's screw or paddle-wheels, increases as the cross-section increases; but increases also as the square of the velocity of the current through the water, multiplied by its velocity with respect to the ship.

Now to propel a vessel at a given speed, a certain force is required, and we can obtain this force either by pushing backward a small stream of water at high pressure or a large volume of water at low pressure. The above equation, deduced by processes so simple as to be within the comprehension of a school boy, shows that we shall lose vastly less energy in the "back-wash" of the propeller by discharging a large volume of water at low speeds.

As we have said above, this is no new fact. But it is one to which the inventors and promoters of jet propulsion schemes have been singularly blind; and these men have been able to command influence enough and money enough to secure trial of their schemes in a number of cases. We give a translation from a German contemporary in another column, describing the jet-propelled boats on the Elbe, the largest of which is shown on our inset sheet. We cannot vouch at all for the accuracy of the figures of tests which are there given; in fact we are inclined to view them with much suspicion, as the figures quoted for resistance of the vessels at the given speeds are far in excess of the thrust which would be obtained from sternward currents of the cross-sections and velocities named in the article. Whatever the explanation of the discrepancy may be, it will be noted that the jets by which the vessel was propelled had a very considerable volume, also that the screw propeller with which the jets were compared was rather small for the size of the vessel. It is not strange, therefore, that the difference between the two was found to be comparatively small. It appears highly probable that a good paddle-wheel engine would have beaten either the screw or the turbine with respect to efficiency.

It is a curious fact that jet propulsion should be taken up at this day in Germany, whose engineers are so noted for subjecting everything to mathematical analysis. The title to the original article from which our translation is prepared, is "Turbinen propeller mit Kontraktor," which explains itself about as well as if it were put into English. It is funny enough in the original article to see how great stress is laid on the importance of the "Kontraktor," the inventor being evidently oblivious of the fact that his "Kontraktor" served only to waste power at the rear of the vessel and absorb a good part of the thrust of his "turbine-propeller."

Returning to the general problem, it is this fact, that for economical propulsion a large volume of water at low speed must be sent astern, which has caused the eventual failure of all attempts at jet propulsion hitherto made. As engineers well know, the screw and the paddle-wheel are better adapted for moving water when a large mass is to be given a low velocity than any form of pump ever devised. The inventors who have worked on jet propulsion have generally proposed to use rotary or centrifugal pumps to set the water in motion, and all such mechanisms have the general objection of being more expensive and complicated, and causing more friction loss in the water than is the case with the paddle-wheel or the screw.

It is fair to say, on the other hand, that there are some slight gains derived by the action of the jet, which serve to mitigate a little the disadvantages already set forth. The propelling power of the jet is exerted directly in line with the axis of the ship, and all the water moved is sent in that direction. In the screw propeller, as is well known, a certain amount of water is sent out in a radial direction by the centrifugal action of the blades, acting like the blades of a centrifugal pump. It is probable, however that the gain of the jet system in this respect is more than counterbalanced by the loss in friction inside and outside of the nozzle of the jet.

The advantages claimed for the jet system of propulsion were enumerated as follows by Mr. S. W. Barnaby in a paper before the Institution of Civil Engineers in 1884,* in which was a very full exposition of the "state of the art" at that time:

> No impediment to speed under sail; no racing due to pitching; no vibration; power of reversing motion in the hands of the officer on deck; full engine power for manoeuvring; vessel capable of being made double-ended; and power of running much increased.

These various alleged advantages served to keep interest alive in the system for many years in England, and brought about some expensive experiments by the British Admiralty to test the feasibility of jet propulsion. All of these proved failures, and except for this latest revival of the system in Germany, nothing has been done in Europe with jet propulsion for a number of years.

* Proc. Inst. C. E., Vol. LXXVII., p. 4.

record the principal facts concerning what was in some respects the most remarkable scheme for jet propulsion ever attempted. We refer to the Jackson jet propulsion system, which excited so much attention in New York city some years ago. A number of inventors, as we stated at the outset of this article, have conceived the idea that efficiency was to be sought for by using a small jet, moving at high velocity. It remained for an inventor named Walter M. Jackson to exploit the idea fully and to test its correctness on a large scale. Seldom has a new invention been put before capitalists with more adroitness and consummate skill than was this, and, according to the inventor's own published statement, $125,000 was invested in the scheme by New York business men. The inventor began by experimenting with a model in a bath tub. Next a small steam launch, which was christened the "Primavista," was purchased and equipped with the new system. This vessel was 50 ft. long, 5½ ft. beam and 3 ft. draft. With a jet ¼ in. in diameter at her stern she was claimed to have been driven at a speed of 10 miles per hour.

There was always a delightful indefiniteness about these performances of the "Primavista," however. We many times endeavored to secure for publication in Engineering News the exact figures with respect to this vessel and her record; but there was always some good reason why the vessel was never just right, and plausible excuses were easier to secure than records.

It would have been the part of wisdom, if the inventor and those interested with him were acting in good faith, to have fully tested the correctness of the supposed principle in this small vessel before engaging in experiments on a larger scale; but inventors are not prone to work in that way. In March, 1888, Dr. Jackson and his friends engaged James Lennox, of South Brooklyn, to build a steam yacht of 160 tons displacement, to be propelled by a jet 1 in. in diameter. This vessel was launched Dec. 11, 1889, and was christened the "Evolution." Her engine was a Worthington compound duplex pressure pump, with two 25-in. h. p. cylinders, two 44.3-in. l. p. cylinders and four pump plungers, each 9 ins. in diameter. The stroke was 37 ins. In the New York "Sun" of January, 1891, an extended account of Dr. Jackson and his inventions was published, containing the only public statement ever made, so far as we know, of the results obtained with the "Evolution." We quote as follows:

After the machinery was in order and everything ready for trial, the "Evolution" was towed into the Erie Basin. Here Dr. Jackson gave dock trials day after day, until finally he made a trip to Hoffman Island and return. The trial was not satisfactory, the main thrust valve leaked badly and upset any possible calculation of efficiency. This valve was a rotating device and calculated to sweep around the circle, discharging the water in every plane direction. After this trip he dry docked the vessel, and substituted a new set of valves, involving new connections with the pilot house and entirely new devices for operating. A 1-in. nozzle was substituted for the 13-16 in. before tried. The boiler behaved much better on the second trial trip, but owing to more cylinder oil being used in the engine than was required the grease extractors in the hot wells failed to remove it, and much oil got into the boiler by means of the feed water, so that it foamed badly. The engines made 19½ strokes, forward and back included, to each engine, the strokes being 37 ins. This produced a piston speed of 120 ft. a minute, which is more than the limit at which the engine should be driven. The hydrostatic pressure was 1,000 lbs. per sq. in. This experiment decided that a 1-in. nozzle was too large, as the limit of pressure was governed by the maximum piston speed of the engine. A nozzle ¾ in. diameter was substituted. Again she went out for a trip to the island. This time 1,200 lbs. hydrostatic was reached, and the vessel recorded 12 knots speed by the log. She could not maintain this pressure, however, for the boiler resumed its lifting of the water and the throttle had to be closed. She ran 10 knots under 1,000 lbs. pressure comfortably and easily, with the throttle one turn open, or open just ¼ in. Careful observations and data were taken by Dr. Jackson on this trip. He was sure that no water which passed the pump could escape anywhere except through the open stern direct thrust valve, for all his stuffing boxes were inside the boat where he could see them. He states that under 1,000 lbs. pressure the engines made exactly 14 forward and back strokes of 37 ins. each way, therefore all the water displaced by the pump plungers passed out of the ¾-in. aperture.

"The "Evolution," displacing 160 tons, was actually driven 10 knots per hour by 213.3 HP. at the jet. No screw or paddle ever came anywhere near this efficiency, and the result proves my theory, founded on sound logic and in correct mathematical issues. I have demonstrated that a jet of water is far more efficient than any other propeller."

As this was the culmination of an experiment which cost, all told, according to the inventor, nearly $200,000, and which was undertaken against the advice of competent engineers who were consulted with respect to the matter, it is perhaps worth while to see what these figures really show.

Taking the inventor's statement that with a nozzle ⅞ in. in diameter, delivering water under 1,000 lbs. pressure, a speed of ten knots an hour was maintained, let us see roughly how much power was lost in the jet leaving the vessel. The area of the nozzle was 0.60132 sq. in. The velocity of the water leaving the nozzle (supposing it to have had the full velocity due to the pressure) was 385 ft. per second. Then the energy in foot pounds per minute equals the weight of water delivered per minute multiplied by the square of its velocity in feet per second and divided by 64.4. Performing the arithmetical computation, which we will not take space to reproduce here, and dividing the result by 33,000 to reduce it to horse power, we find that under the conditions stated no less than 420 HP. of the energy developed by the pumps was devoted to sending that small but intensely powerful jet of water out at the vessel's stern.

On the other hand let us see how much energy was devoted to actual propulsion of the vessel. If the nozzle was .60132 sq. in. in area and the water left it at 1,000 lbs. per sq. in., the reaction, or thrust tending to push the vessel forward was just 601.32 lbs. If the speed, as Dr. Jackson claimed, was 10 knots per hour, which is equivalent to 1,014 ft. per minute, the work done on the vessel was equal to the force multiplied by the distance passed over, and dividing by 33,000 as before to get the result in horse power, we find that about 18 HP. was the total amount expended in doing useful work. Thus in its dynamic relations the "Evolution" was not unlike a good rifle. The bulk of the energy developed by the engines went to drive a continuous water projectile astern at enormous velocity, and only a slight backward "kick" was actually exerted in propelling the vessel.

There is only one point in the foregoing solution the correctness of which can be called at all in question. We have assumed that the velocity of the jet of water was the theoretical velocity due to the pressure at the plane of the orifice; but it may be argued that it is not positively known that a jet enters the water with the same velocity that it would the air. It is at least conceivable that the water might retard the entrance of a jet of such enormous velocity, so that the actual velocity would not be that due to the pressure, but would be some smaller velocity. On this possibility the sole grain of hope for the partial success of Dr. Jackson's system has always rested. We believe that all experimenters and authorities agree that the efflux of a jet in water is the same as in air (the pressure at the plane of the orifice being the same); but no experiments, so far as we know, are on record where such very high pressures as 1,000 lbs. per sq. in. were used.

Fortunately, we have in the figures given by the inventor himself, in the article above quoted, a means of testing this. Under the stated conditions the pumps are said to have made 14 revolutions per minute; there were four 9-in. pump plungers, single acting, of course, to work at such high pressures, and the stroke is given as 37 ins. With these dimensions, computing the volume and then the velocity of the water leaving the orifice is an easy matter, and we find it to have been 305 ft. per minute. Remembering that Dr. Jackson's figures given above, "1,200 lbs. pressure," "1,000 lbs. pressure," etc., are all round numbers and probably a considerable variation from those actually indicated, this figure of 305 ft. per minute agrees as closely as could be expected with the 385 ft. theoretically due to 1,000 lbs. pressure.

Something—perhaps a good deal—might be added concerning the probability of a 160 ton vessel being driven at 10 knots per hour by a thrust of only 600 lbs., but we leave our readers to compute probabilities in this direction for themselves. We would like also to give our readers some extracts from a treatise entitled "New Method of Hydraulic Marine Propulsion," which the inventor of this remarkable system wrote and published. But we have already devoted sufficient space to the record of a scheme much more remarkable as an experiment on human nature than as an experiment in applied mechanics. We can give our readers an idea, however, of the book, of its author, and to some extent of his invention as well, by quoting one of his favorite sayings, which appears in the introduction to his book, and which, comically enough, he poured into the receptive ear of the "Sun" reporter, who set it down in cold print in the same article that related the results obtained with the "Evolution," which we have computed above. The quotation is as follows:

I have not blundered upon a discovery, or fallen from the tenth story of a building into a supposed gold mine. My conclusions are all based upon a strict scientific analysis of cause and effect. I did not dream out any of my coefficients, or receive my conclusions by virtue of any special inspiration; simply faithful, systematic thought, stimulated not by a desire to make money, but by a determination to learn the truth.

THE BULGING OF THE ENDS OF FREIGHT CARS.

The distortion of the end framing and the bulging out of the ends of freight cars are accidents with which every master car builder is familiar. Not only does this occur with old cars, where the light, old-fashioned construction and deteriorating effects of long service might be expected to develop a weakness with the present fast freight schedules and heavy engines, but it is common to the most modern construction and cars of heavy capacity. At the last quarterly meeting of the Southern and Southwestern Railway Club a committee, consisting of Messrs. E. M. Roberts (E. Tenn., Va. & Ga.), A. G. Steinbrenner (P. R. R.), and J. W. Holt (R & D.), presented a careful report on this subject and discussed the question of how best to remedy the evil.

The evil was considered to be due (1) to the unnecessarily rough handling of cars in switching and the shocks caused by sudden application of the brakes, causing the loads to shift, and (2) to the inherent weak construction of the end framing, which had not been increased in strength in proportion with the increase in the size and loads of the cars. The destructive results of the shifting of the contents are dependent upon the severity of handling of the cars, conditions of loading, the susceptibility of the lading to shift, and its capacity to do injury. There is a constantly growing recklessness in handling cars in the yards, brought about by the use of power brakes on engines and tenders and the high speed at which the switching can be done. The shocks to which cars are subjected in switching are enormous. The ease with which the load shifts and its capacity to do injury are both important elements in the destruction of car ends. Grain and lumber are especially injurious, more cars with bulged ends being found in the grain districts than anywhere else.

The remedy for rough handling of cars rests with the transportation department of railways. The claim that rapid switching is necessary in order to handle the cars with the present crews is doubtless true; but it is false economy, as the extra expense for repairs will more than counterbalance the extra cost of additional help to do the switching carefully. Most general managers would be surprised to know how large a part of their freight car repair account is due to unnecessary damage done in the yards.

The end framing of freight cars is inherently weak and is entirely unable to withstand the shocks to which it is subjected. The usual mortise and tenon jointing is especially liable to develop weak points and break. The remedy for this is obviously to improve the design and increase the strength of the framework. An end framing which is suggested is as follows:

Middle end posts, 4 × 4½ ins., with a belt strip composed of 4 × 3⅝-in. stuff, rabbeted to insert the short leg of a 2 × 4-in. T iron. This belt strip is fastened to side belt rail, with angles inside and outside of car. In the corners, at intersection of side and end plate, a cast or malleable knee (with rib in center) on inside, and wrought angle on outside, taking same bolts. Posts and braces rest on cast or malleable pockets, and with shoes on top, with flange 1½ ins. projecting above bottom of end plate on inside. Strips 1½ × 4½ ins. are bolted on inside of corner and intermediate posts with ½-in. bolts or lag screws. The end framing is further reinforced by heavy pieces bolted and screwed to the outside of middle posts and rabbeted to receive the sheathing, which is applied diagonally, to better brace and support car framing. The deadwoods are extended above the top of end sill, to better prevent end post giving way at the end sill.

We may appropriately conclude by placing on

TESTS OF ASPHALT PAVING MATERIALS AT PHILADELPHIA.

A joint committee from the Citizens' Municipal Association and the Trades League of Philadelphia, of which Arthur H. Lea and Robt. M. McWade, respectively were chairmen, recently undertook an investigation of asphalts available for paving in Philadelphia. The report of the committee was made, in pamphlet form, on May 25, 1894, and we have abstracted it as follows:

The report is addressed to Jas. H. Windrim, Director Department of Public Works, Philadelphia, and opens with a statement that the investigations were undertaken in view of regrets expressed by Mr. Windrim to the effect that he was "not provided with the means and facilities for determining certain important questions connected with the subject of asphalts, though such facilities were at the command of municipal officers elsewhere."

The committee engaged the following experts to conduct its tests: Professors Samuel P. Sadtler, Ph. D., and Henry Leffmann, M. D., chemists; Prof. Lewis M. Haupt, Engineer; T. B. M. Addis, Expert in Paving; Booth, Garrett & Blair, Engineers of Tests.

Upon expressing its desire to investigate without charge any asphalt offered for paving in Philadelphia, the committee found itself confined to only two asphalts, the Trinidad Lake, now used in Philadelphia, and the Bermudez Lake. The California Petroleum & Asphalt Co. made a formal application for an examination of its materials and then withdrew it.

After classifying and reviewing the various materials which have been used as the basis of the manufacture of asphalt pavements in this country and Europe the committee's experts state, in their report, that they consider asphaltic limestone or natural rock asphalt pavements too slippery for use in Philadelphia, although very durable. Asphalt and coal tar mixtures are also considered out of the question, largely on account of their condemnation in Washington, after a trial of several years. Of the mixtures of natural bitumens and oil residuums only the Trinidad and Bermudez could be tested, for the reason already stated.

The experts obtained samples of Bermudez asphalt from the works of the New York & Bermudez Co. at South Amboy, N. J., and of Trinidad asphalt from the works of the Vulcanite Paving Co., Philadelphia, selecting samples of the refined and crude products by personal visits to each works. Both the crude and the refined Bermudez asphalt "showed a bright, pitchy luster, were brittle at ordinary temperatures, but capable of bending on slight pressure. Both are plastic enough to run together gradually at 60° F." The crude Trinidad asphalt was a piece of so-called "cheese asphalt," "brownish black and earthy in appearance, and the refined was a dull black, lustreless material, sufficiently brittle to break with a blow into splinters, but not plastic enough to change its shape at ordinary temperature." The specific gravity and percentage of ash, or incombustible mineral matter, of the two crude asphalts were as follows:

	Specific gravity.	Percentage of ash.
Bermudez	1.032	2.63
Trinidad	1.292	33.72

A brief description of the refining processes of the two asphalts is given in the report, from which the experts seem to convey the idea that the Bermudez shows points of superiority in this connection. The experts next give the following comparative analyses of the two refined asphalts:

	Trinidad.	Bermudez.
Specific gravity at 60° F.	1.373	1.071
Bitumen soluble in carbon disulphide.	61.507%	97.22%
Mineral matter or ash.	34.51 "	1.50 "
Non-bituminous organic matter.	3.983 "	1.28 "
Portion of total bitumen soluble in alcohol.	8.24 "	11.66 "
Portion of total bitumen soluble in ether.	80.01 "	81.63 "
Loss at 212° F.	0.65 "	1.37 "
Loss at 400° F., in ten hours.	7.98 "	17.80 "
Loss at 400° F. calculated to amount of bitumen present.	12.811 "	18.308 "
Evolution of hydrogen sulphide at.	410° F.	none at 437° F.
Softening point	160° F.	113° F.
Flowing point	192° F.	150° F.

The experts next secured samples of the other components of the two pavements, oil residuums, clear sand and powdered limestone, securing by a personal visit the Trinidad samples and accepting from the Bermudez people samples selected by their chemist, Dr. De Smedt. The Trinidad samples were prepared in accordance with the specifications of the Philadelphia Department of Public Works, which state that:

The refined asphalt and residuum oil will be mixed in the following proportions by weight: Asphalt 100, petroleum 16 to 22. The asphaltic cement, made in the manner above described, will be mixed with other materials in the following proportions, by weight:

	Parts by weight.
Asphaltic cement	13 to 16
Sand	58 to 63
Stone-dust	23 to 28
Pulverized carbonate of lime	5 to 3

Regarding the Bermudez test samples, the experts may be quoted as follows:

In making the Bermudez cement and paving composition, we took the proportions furnished us by Dr. De Smedt, the chemist of the New York & Bermudez Co. This was as follows: Asphalt 100, oil residuum 11. This cement was then to be mixed as follows:

	Parts by weight.
Asphaltic cement	10.15
Sand	74.85
Pulverized carbonate of lime	15.

In comparing this with the composition of the Trinidad paving mixture, we noticed such a difference that we determined to make up a mixture from Bermudez asphalt which, after taking into account the difference in mineral residue of the two refined asphalts, would bring them more nearly to an equality of composition. We, therefore, made a mixture of asphalt cement, composed as stated above, with a different proportion of sand and pulverized carbonate of lime. This mixture was:

	Parts by weight.
Asphaltic cement	10.15
Sand	59.85
Pulverized limestone	30.00

With these mixtures, hereafter referred to as "Trinidad Mixture," "Bermudez No. 1," and "Bermudez No. 2," we determined to make tests of tensile strength, or rather, cohesive strength, at different portions and of compression tests at different temperatures.

The composition of the mixtures may be expressed in percentage numbers with very close approximation to the figures given above, and the figures thus taken are entirely within the limits of the specifications referred to. The percentage composition then is:

	Trinidad.	Bermudez No. 1.	Bermudez No. 2.
Asphalt	12.5	9.1	9.1
Oil residuum	2.5	1.0	1.0
Sand	58.0	75.0	..
Crushed stone	23.2	..	60.0
Pulverized limestone	3.8	15.0	30.1
	100.0	100.0	100.0

The mixtures and briquettes for tension or cohesive tests were prepared on the afternoon of May 14 under the direction of Drs. Sadtler and Leffman. The tests were made the following day, beginning at 4.45 p. m., by Mr. Frederick H. Lewis, of Booth, Garrett & Blair, mentioned above. The briquettes were of the same size as those used in testing cements—area of center section, 1 sq. in. The briquettes for compression, 2-in. cubes, were made during the afternoon of May 15 and tested the following day, beginning at 4.45 p. m. The results of the cohesion and compression tests at different temperatures are given by the experts as follows:

Cohesion tests at 32° F.

	Trinidad mixture. Pounds.	Bermudez No. 1. Pounds.	Bermudez No. 2. Pounds.
Broke at	138	453	480
" "	155	345	537
Average	146.5	399	508.5
Cohesion tests at 64° F.			
Broke at	53	103	206
" "	58	130	202
Average	55.5	116.5	204
Cohesion tests at 108° F.			
Broke at	20	12	37
" "	18	28	52
Average	19	20	44.5
Compression tests at 32° F.			
Ultimate strength.	4,140	7,000	7,000
or per sq. in.	1,027.5	1,750	1,750
Compression tests at 65° F.			
Ultimate strength.	2,190	....	2,670
or per sq. in.	547.5	....	667.5

The report also contains an account of a visit to Washington on the part of the committee and its representatives to examine Bermudez and Trinidad asphalt pavements there in actual use. Samples of both kinds of sheet paving from the Washington streets were taken and afterwards tested, together with samples of Trinidad paving from streets in Philadelphia. The general conclusions from the Washington visit and the subsequent examinations are given in the summary further on. Some particulars regarding the effect of water on asphalt pavements in Washington and a general consideration of this phase of the subject may now be quoted from the report, as follows:

The question of the effect of water, and particularly of standing water, upon the several asphalt paving compositions was a matter that your committee wished particularly looked into. As to the effect of water upon Trinidad asphalt paving composition, the experience in Washington has been quite decisive, and except on streets where the gradient is considerable and drainage therefore rapid, the gutters are ordered to be paved with vitrified brick or other similar material. From the reports of the District Commissioners abundant testimony can be had as to their opinion on this matter based upon practical observations. Thus, in the report for 1886-'87, page 65, we find in the discussion as to merits and demerits of coal-tar distillate mixtures, the following from Capt. Eugene Griffin, Corps of Engineers, U. S. A.:

It can be laid from curb to curb, as it will not rot in the gutter, as does the asphalt. Asphalt pavements also disintegrate badly when weather cracks have formed, these acting as gutters to receive and hold the surface drainage.

In the report for 1888-'89 we find, under the head of specifications for standard asphalt pavement (see p. 189), mention of another expedient for protecting the asphalt composition in the gutters. It says:

Where gutters are not paved with granite blocks or bricks, they will for a width of three feet be painted with No. 4 paving tar and ironed with hot smoothing irons. After the curb is set and pavements laid, hot paving tar will be poured into the joints of the curb until it rises and remains at the level of the pavement.

Mr. Clifford Richardson, formerly Inspector of Asphalt and Cements for the District of Columbia, in a report made to the Commissioners, April 24, 1893, says:

Bermudez asphalt possesses the decided advantage over Trinidad pitch of containing little organic matter of a non-bituminous nature and no soluble salts, and in consequence it is not attacked by water, and would, therefore, not rot in the gutters as Trinidad frequently does.

This statement, proceeding from abundant experience, is of special interest to the citizens of Philadelphia, who have recently suffered from excessive dust, owing to the contractors' fear of damage which might be done by water to Trinidad asphalt pavements by frequent sprinkling. The Bermudez asphalt appears to have the very important advantage of being less susceptible to damage by water.

In the report of the District Commissioners for 1893, p. 110, Mr. Geo. H. Bailey, computing engineer in charge of repairs and improvements to streets, says:

For the past year's work the practice has been generally followed of paving the gutters of asphalt roadways for a width of two feet with vitrified brick. The use of this material in such situations has proved very satisfactory, especially on streets with light gradients. It gives a surface about as smooth as asphalt and removes the danger of disintegration and decay occasioned by standing water on an asphalt surface.

Some experiments were made by us on the question of the action of water upon the fragments of pavements before referred to. At ordinary temperatures, the Trinidad pavement composition shows after some hours a brownish color on the surface, and in the course of a day or two this is sufficient to rub off upon the fingers, when a fresh brownish film forms. This clearly indicates a surface disintegration. With the Bermudez asphalt composition no change in color appears, nor could any film be rubbed off after several days' standing. The several samples (Trinidad pavement from Market St. Bridge, Trinidad pavement from Broad and Arch Sts., both in Philadelphia, and Bermudez pavement sent by T. H. Thomas from Washington) were also tested by two hours' immersion in water at 130° F. Under these circumstances the two Trinidad samples showed appreciable disintegration on the surface and left a sandy deposit in the beaker glass, quite recognizable as coming from the fragment tested. The Bermudez sample softened somewhat, but left no appreciable deposit due to disintegration. This test is more severe than any to which the street paving is likely to be subjected in ordinary use.

General conclusions regarding the results of the investigation, signed by Professors Sadtler and Leffmann, are as follows:

(1) The analyses show that the Bermudez is a very pure bitumen, containing, as it does, 97.22% of material soluble in carbon disulphide. A large proportion of this is also soluble in ether, indicating a high percentage of the so-called "petrolene" which gives cementitious value to compositions in which it enters. In both these respects it seems to be superior to Trinidad asphalt.

(2) The analyses show that the percentages of mineral and organic non-bituminous matter are notably less in the Bermudez than in the Trinidad asphalt. The absence of much mineral matter makes it possible for the Bermudez asphalt to make more paving composition than the Trinidad asphalt, taken ton for ton. The organic non-bituminous matter is an injurious constituent, and its presence in any quantity is undoubtedly largely responsible for the "rotting" and disintegration of the Trinidad pavement in street gutters.

(3) The tests of cohesive strength show that paving compositions can be made from Bermudez asphalt that are stronger at all temperatures than the composition of Trinidad asphalt now being used in Philadelphia, and are equal if not superior to the Trinidad asphalt composition as used in Washington.

(4) The compression tests also show a distinct superiority for the Bermudez asphalt compositions as made by us over the Trinidad asphalt composition in use in Philadelphia.

(5) The experience in Washington, as well as our own experiments, show that the Trinidad asphalt pavements are gradually disintegrated by the continued action of moisture, particularly where water stands for a time in contact with the surface, as in the gutters. In our experiments the Bermudez asphalt composition seemed to be affected notably less, a difference we attribute to the presence of soluble salts and organic non-bituminous matter in the Trinidad.

We therefore believe that your committee is abundantly justified in urging upon the municipal authorities the opening of sheet-asphalt paving in Philadelphia to parties using Bermudez asphalt. It is surely the best municipal policy to utilize a material which promises so well under severe tests to effect an improvement in the quality and durability of such pavements, and we need not point out the fact that competition will tend to secure these advanages, coupled with a reduction in cost.

The report ends with an engineering report by Prof. Haupt and Mr. Addis giving the results of their inspection of the Washington pavements. They state that the Bermudez pavements were found by them to be in good condition, but from a list showing the area covered by this pavement it appears that it was all completed in the latter third of 1893, except on one street, where the date of completion was May 18, 1894. The area of Bermudez pavement in Washington, as given in the list, is 19,720 sq. yds., in connection with which there are about 2,100 sq. yds. of vitrified brick gutters.

The 1893 bids for asphalt pavements in Washington are given as follows:

	Concrete base.	Price per sq. yd.
Bermudez	4	$1 90
"	6	2.10
Trinidad	4	1.93
"	6	2.18½

The report states that by act of Congress, contracts for asphalt paving in Washington cannot be awarded at a price exceeding $2.25 per sq. yd. From the time this act went into effect until there was competition the contract price for work done was $2.25 per sq. yd. for asphalt on a 6-in. base and $2 for a 4-in. base.

Profs. Haupt and Sadtler close their report as follows:

Thus you will see that although the price for asphalt pavement on a concrete base in Washington was much lower than that paid in Philadelphia, yet open competition has brought it down to a still lower figure, and we believe with better results.

Philadelphia, where there has been no competition for a number of years, has been paying for her asphalt pavements laid on a 6-in. concrete base prices ranging from $2.60 to $2.95 per sq. yd., and on the so-called "bituminous" or "vulcanite" base from $2.40 to $2.60 per sq. yd.

Taking the average of the 6-in. concrete pavement in Philadelphia at $2.77, and the present quotations of $2.10 in Washington, we have a difference of 67 cts. per sq. yd. against Philadelphia. We believe that if we had open competition here we could save at least 50 cts. per sq. yd., and secure better results.

Our existing specifications permit the use of a 4½-in. base of broken stone without cement. This is one of the main causes for the rapid disintegration of the asphalt pavements here, as well as for the large expenditure for repairs, and should be discontinued.

We would recommend that a concrete base be required under all asphalt pavements, as is now done in Washington.

The question of the relative merits of different asphalts and of the durability and reliability of asphalt paving is one of such great importance at the present time that we have made some further investigations with reference to this report, and present herewith letters addressed to this journal by Prof. H. C. Bowen, of the Columbia School of Mines, a chemist who has given special attention to the subject of asphalts and their composition for some years, and by Mr. Clifford Richardson, Assoc. Am. Soc. C. E., who was for many years Inspector of Asphalts and Cements for the District of Columbia, and who is extensively quoted in the report of Messrs. Sadtler and Leffman. The letters are as follows

Sir: I beg to offer the following remarks on the Asphalt Paving Report, published lately by the Citizens' & Trades' League Committee in Philadelphia:

The report seems in part to have been piloted by interests other than independent and scientific investigators. They admit a main cause of rapid disintegration of Philadelphia asphalt pavements to be the poor 4½-in. base laid without cement. The investigation was conducted in three ways, as follows:

(1) Chemical.—It is not a proper conclusion by these experts (in other matters than asphalt) that one asphalt is better than another because soluble to a greater degree in bisulphide of carbon. This reasoning would put coal tar ahead of asphalt.

As to composition of Bermudez (Venezuela) asphalt No. 2 we find that 90% of sand and dust had to be added to bring it to the same state as Trinidad pavement. The Trinidad asphalt contains a natural fine grit which is an advantage it possesses over the Bermudez.

Their tests indicate a difference of 1.6 soluble in ether, and the strange inference is drawn that Bermudez containing more petrolene is therefore more cementitious.

The conclusion is drawn that non-bituminous matter in Trinidad asphalt causes rotting in gutters. The very limited tests of these "analyses" warrant no such conclusion.

Every observer of the Trinidad Asphalt Lake knows that pools of water stand on the lake for years, and that the asphalt itself from under this water shows no absorption of water. Moreover the water is fresh and sweet, and is used by the people on and around the Asphalt Lake for drinking.

The chemical analyses and data given, beginning with "specific gravity" and ending with "flowing point," seem to have been incorporated from those of the chemist of the Bermudez Co., and not to have been made by any one of the experts of this report.

(2) Physical Tests.—All who have studied in a practical way the subject of asphalt paving and the demands of traffic upon it know that crushing and tensile strength are not very important. These tests do not indicate the kind of asphalt pavement which will endure traffic nor fulfill the needs of a pavement. No one doubts that a rubber surface fixed to a firm foundation and having a proper yielding and recovering power and toughness, would make a good pavement. Yet its capabilities cannot be determined by crushing and tensile tests.

It is not proper nor possible to make "bituminous concrete briquettes" of like composition and equal compression as undertaken in these tests, and thus compare the qualities of the different kinds of asphaltum (pure) by this plan. Exact conditions are imperative.

It should be noted that the Bermudez mixture contains 24% more asphaltum than that in the Trinidad sample. For the 12.5 grams of refined Trinidad is closely 57% asphaltum, whereas 9.1 grams in the Bermudez is 97%, consequently the asphaltum involved stands 7.1% in the former to closely 8.8% in the Bermudez. The conclusions drawn, that the higher the tensile and crushing strength the better the asphalt, are evidently too hasty. What would have been the result if coal tar had been used? They would have found higher figures than for Trinidad and Bermudez briquettes, notwithstanding it is well known that coal tar is inferior to Trinidad asphalt for paving.

(3) Inspection.—This inspection by "experts" disclosed imperfections traceable to imperfect workmanship, depressions and elevations, uneven surface, rotting gutters, things found in pavements of the past. The report fails to mention the possible effects of defective workmanship and bad compoundings, which must appear in building the many miles of pavement while the industry was developing. Rotting of Trinidad pavement is scarcely known to-day. The gutter construction is now carried to a high degree of durability. The facts which are supposed to be brought out in this pamphlet rest on frail foundations. The resistance of asphalt pavement to street traffic and conditions is due to properties of asphalt other than those considered by the experts. H. C. Bowen, Chemist,

Columbia School of Mines, New York, June 18, 1894.

Sir: The following are my comments on the Philadelphia asphalt report, being a letter addressed to Jas. H. Windrim, Esq., Director of the Department of Public Works, of Philadelphia:

There has recently been brought to my attention a pamphlet entitled "Reports of Experts Appointed by Special Sub-Committees of the Citizens' Municipal Association of Philadelphia and of the Trades League of Philadelphia to Investigate Asphaltic Materials Available for Street Pavements in Philadelphia." I find in those portions of the report which relate to the relative merits of Trinidad and Bermudez asphalts so much that is calculated to mislead, and such a misinterpretation of the facts and of the results of the experiments which have been conducted, that my previous experience and interest in this question compel me to call attention to some of the erroneous conclusions there drawn.

Tests for tensile strength of briquettes of Trinidad and Bermudez asphalt surface mixtures are very deceptive, because the asphaltic cement is but one factor in the physical properties of the briquette and of the result of the tests, while the size of the sand, the amount of impalpable dust in use and the density of the briquette are much larger, more important and more controlling elements.

I have, during the past two years, made extended physical and chemical tests of the two asphalts under consideration, including a number for tensile strength at different temperatures. The results of tensile strength tests, it was found, could be made to appear either in favor of the one or the other asphalt in accordance with the conditions employed in making the briquettes. The principal factor in influencing the results is the density which is obtained in the briquettes. With high density, Trinidad asphalt will give slightly higher results. With low density the reverse is the case. In the Philadelphia experiments the density of the test pieces is not given, and it is therefore impossible to judge the results properly. The accompanying tables, which give the results of tensile strength tests of surface mixtures of Trinidad and Bermudez made in this laboratory show quite a different state of affairs (especially in connection with Trinidad asphalt) from the results obtained in the laboratory of Messrs. Booth, Garrett & Blair.

Where surface mixtures of Trinidad and Bermudez asphalt cement were made under uniform conditions, it was found that, with very thorough compaction, and a consequent high density, that both mixtures have almost the same tensile strength at low temperatures, while at high temperatures those of Trinidad asphalt withstand a greater strain. If the briquettes are, however, not well compacted, the results are the reverse. This is due to the less viscous nature of the Trinidad cement, which, in mixtures not thoroughly compacted would not withstand tensile strain as well as the more viscous Bermudez. In a street surface, which was so laid as to receive its ultimate impression, there would be no preference for either asphalt in tensile strength at low temperatures, and a small one in favor of Trinidad at high temperatures.

The Philadelphia tests of tensile strength seem, in the light of my experiments, to be not fairly suited for comparison of Trinidad and Bermudez cement. Granting, however, that the Philadelphia results are correct, their interpretation by the experts is erroneous. This will appear from a study of the nature of bituminous cement in general in connection with the tests for crushing strength.

If the experts had added glance pitch, coal tar or even land pitch to their series of experiments, they would have found that these materials, which are recognized as being worthless for paving purposes, would have a greater tensile and crushing strength than either Bermudez or Trinidad Lake asphalt.

In the following tables I submit the results which were obtained in the course of my investigations to illustrate this point:

Average Tensile Strength of Asphalt Surface Mixtures.*

	Trinidad at 40°F.	Trinidad at 77°F.	Trinidad at 100°F.	Bermudez at 40°F.	Bermudez at 77°F.	Bermudez at 100°F.
	—Lbs. per sq. in.—			—Lbs. per sq. in.—		
Series 1. 1892.						
Dense	477	177.5	61	406	157	50
Series 2. 1894.						
Less dense	431	131.	..	543	162	..
Series 3. 1894.						
Densest	604	205.	..	611	171	..

* 10% dust and Washington sand in all mixtures.

Average Tensile Strength of Asphalt Surface Mixtures.* with Varying Proportions of Limestone Dust.

Dust. %	Tensile strength at 38° F. Trinidad.	Tensile strength at 38° F. Bermudez.	Tensile strength at 77° F. Trinidad.	Tensile strength at 77° F. Bermudez.
	Lbs. per sq. in.		Lbs. per sq. in.	
7.5	501	449	188	111
10.	604	611	205	171
15.	646	662	273	186
20.	701	857	270	192

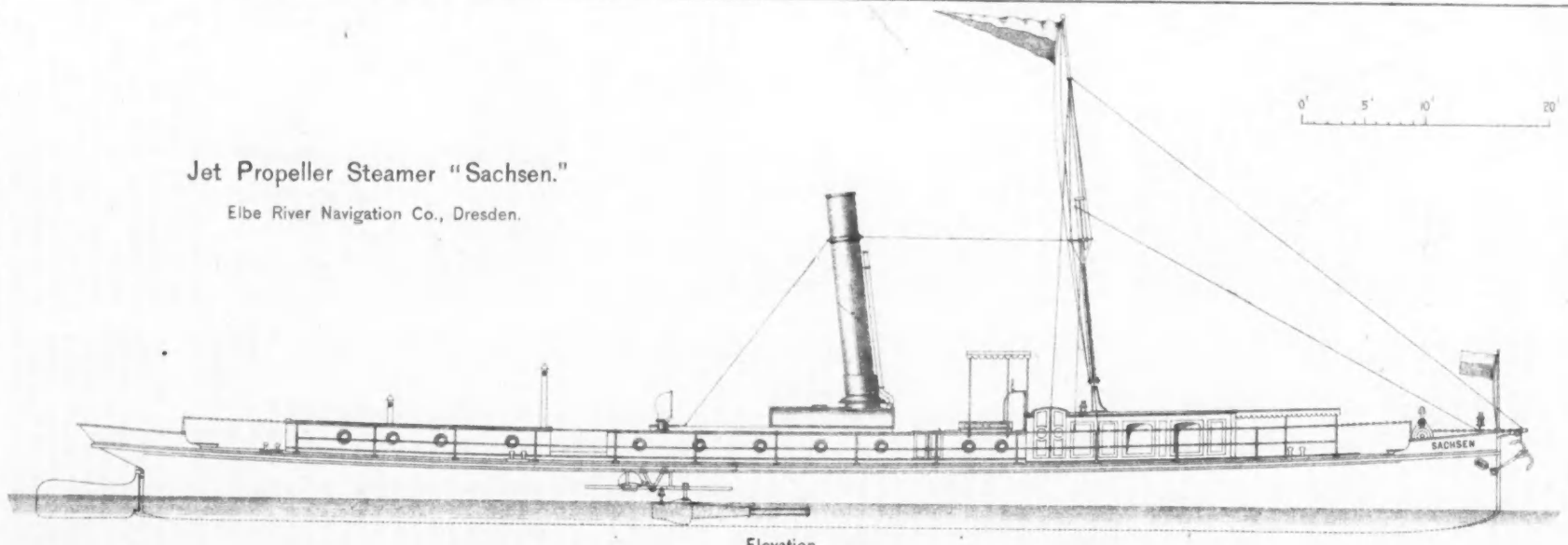
Average Comparative Crushing Strength of Surface Mixtures* of Coal Tar, Trinidad Lake and Land Asphalt, and Bermudez Asphalt.

	Density.	Crushing strength. At 38°F.	Crushing strength. At 77°F.
		Lbs. per sq. in.	
Coal tar, 15%	2.16	3,880	1,254
" " 10%	2.07	3,845	2,655
Land pitch, 10% bitumen	2.13	1,813	761
Bermudez cement, 10% bit.	2.10	1,955	635
10% bitumen	2.06	2,125	550
Lake pitch, 10% bitumen	2.14	1,375	548

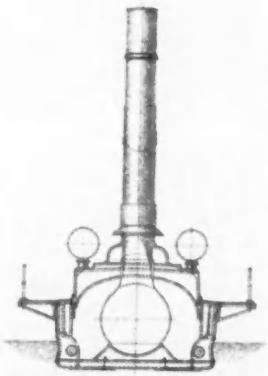
* 10% dust and Washington sand in all mixtures.

Jet Propeller Steamer "Sachsen."

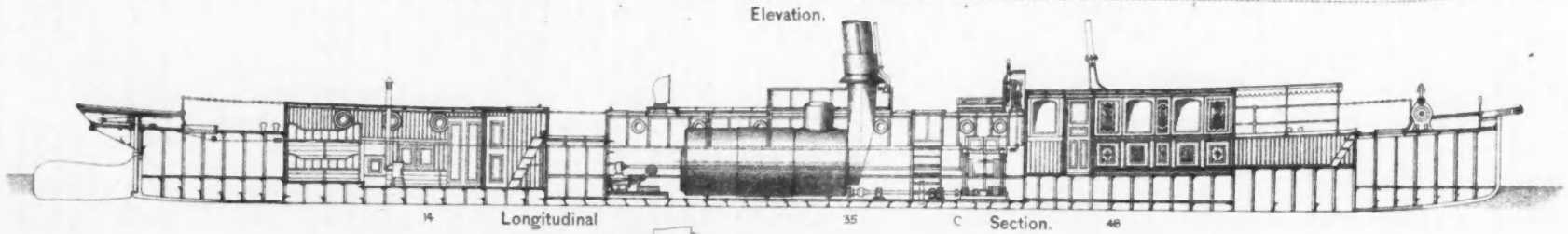
Elbe River Navigation Co., Dresden.



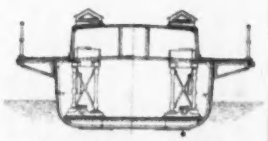
Elevation.



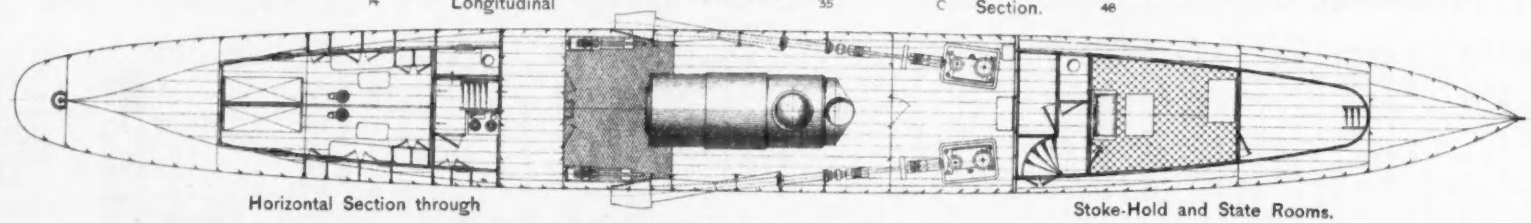
Cross Section, Frame 35.



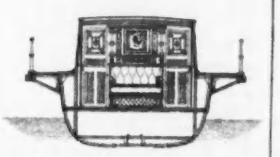
Longitudinal Section.



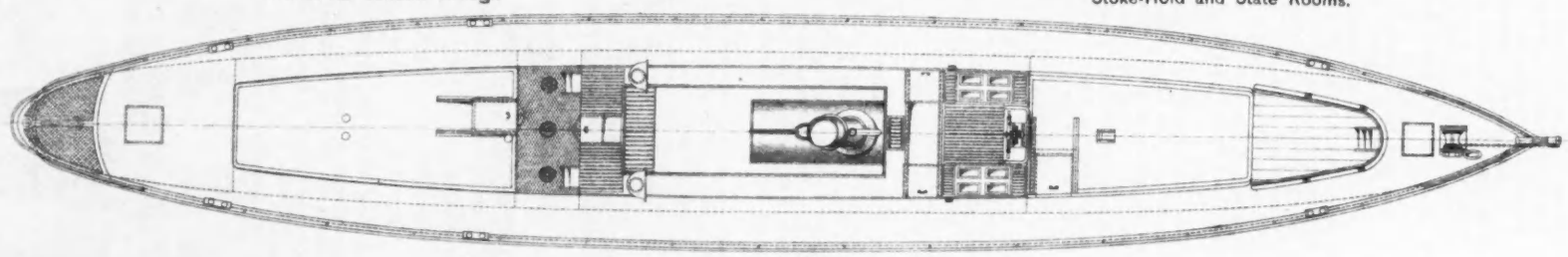
Cross Section, Frame C.



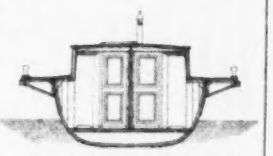
Horizontal Section through Stoke-Hold and State Rooms.



Cross Section, Frame 48.



Deck Plan.



Cross Section, Frame 14.

It will be seen that the conclusion that the cementing material which gives the greatest strength in bituminous concretes must be the most valuable one for paving purposes, based upon our methods of interpreting similar tests with hydraulic cement concrete, is entirely incorrect. We find that coal tar, which is of no value for paving purposes, gives a very much higher crushing strength than any of the other bituminous cements and that land pitch, which has been proved to be inferior, resists crushing better than the Uvalde lake asphalt. We are dealing with viscous materials, the most viscous being the most brittle and least suited for paving purposes. The best cementing material is the one which, with the least viscosity, at a proper consistency for use as a paving cement, will still resist impact at all temperatures, not being too soft at high or too brittle at low. Those which become brittle at low temperatures give, like hydraulic cements, high tensile and crushing tests, while the best for paving purposes continue to yield even at 32° F., and consequently, although having life and cementing power at that temperature, give lower results for crushing and tensile strength than the more viscous and brittle tar and land asphalts. The true deduction, then, from the expert figures is, that at both temperatures given Trinidad asphalt is the most yielding and would resist impact better, and consequently prove a more valuable cement for paving purposes.

As to the report of the experts in regard to the inspection of Washington pavements, the conclusions drawn seem to show a lack of understanding of the conditions there existing. They could see no Bermudez surface that was even a full year old, and yet they compare this with Trinidad pavements that are cracked because they have been down for years. No lake asphalt surface can be found in Washington of the same age as Bermudez surface, which shows a crack or defect.

The final conclusions and objections of these gentlemen may be quoted and replied to paragraph by paragraph, as follows:

1. The analyses show that the Bermudez is a very pure bitumen, containing, as it does, 97.22% of material soluble in carbon bisulphide. A large proportion of this is also soluble in ether, indicating a high percentage of the so-called "petrolene," which gives cementitious value to compositions in which it enters. In both of these respects it seems to be superior to Trinidad asphalts.

The purity of the bitumen is of no importance technically. It must eventually be mixed with mineral matter, and all the impurities become at once a part of the mineral aggregate. The relative amount of petrolene is not essentially different, 80.01 for Trinidad and 81.63 for Bermudez, according to their own figures. In the light of my experience I can see no way of basing a conclusion on these grounds that Bermudez is essentially superior to Trinidad asphalt for paving purposes.

2. The analyses show that the percentages of mineral and organic non-bituminous matter are notably less in the Bermudez than in the Trinidad asphalt. The absence of much mineral matter makes it possible for the Bermudez asphalt to make more paving composition than the Trinidad asphalt, taken ton for ton. The organic non-bituminous matter is an injurious constituent, and its presence in any quantity is undoubtedly largely responsible for the "rotting" and disintegration of the Trinidad pavement in street gutters.

The mineral matter in Trinidad asphalt is an impalpable, sharp quartz sand, intimately and homogeneously mixed with the bituminous constituents. This sand is one of the valuable features of the pitch, and when absent, as in the Bermudez asphalt, must be made up by the addition of ground limestone, or other impalpable dust, which cannot be done with that uniformity in the gross paving mixture that is found in the natural product, although such an intimate addition can, perhaps, be made in the laboratory.

The small amount of "organic matter not bituminous" in which, according to the analyses of the experts, Trinidad exceeds Bermudez asphalt, 2.7%, can hardly be of any great injury when mixed with the 90% of the mineral aggregate in the surface. Further researches, soon to be published, have modified some of the conclusions which I drew in the early days of the industry and show that this is an unfortunate name and should be changed, for reasons which cannot be entered upon here. It appears that a portion of what was originally considered non-bituminous organic matter is really material which was soluble with difficulty in the cold solvents which were used until lately. I have become convinced, from my experience, that the rotting of gutters, which is attributed to the non-bituminous organic matter in Trinidad asphalt, is really due to lack of compaction and density; and I can show many gutters of Trinidad asphalt which, having been properly laid and compacted, are in good condition after years of use. Of course many poor gutters, due to bad workmanship, give way.

3. The tests of cohesive strength show that paving compositions can be made from Bermudez asphalt that are stronger at all temperatures than the composition of Trinidad asphalt now being used in Philadelphia, and are equal, if not superior, to the Trinidad asphalt composition as used in Washington.

4. The compression tests also show a distict superiority for the Bermudez asphalt compositions as made by us over the Trinidad asphalt composition in use in Philadelphia.

My answer to the above conclusions has been already given. The results, if of any value, are in favor of Trinidad, since it is more yielding at all temperatures than the other bituminous cements and will consequently withstand impact better although giving lower results with the testing machine.

5. The experience in Washington, as well as our own experiments, show that the Trinidad asphalt pavements are gradually disintegrated by the continued action of moisture, particularly where water stands for a time in contact with the surface, as in the gutters. In our experiments the Bermudez asphalt composition seem to be affected notably less, a difference we attribute to the presence of soluble salts and organic non-bituminous matter in the Trinidad.

After an experience of many years with Washington pavements, I would challenge the experts to show in that city a Trinidad asphalt surface of the same age as that laid with Bermudez cement which is in the most minute degree affected by water. In this last conclusion the experts have again compared old Trinidad surfaces with those of Bermudez asphalt which are not yet a year old. Experience extending over only a few weeks or even months with the latter material will not demonstrate its capabilities of resisting water better than Trinidad asphalt.

The entire conclusions advanced in the report which I have reviewed seem to me, therefore, to have the appearance of being drawn by advocates of Bermudez asphalt rather than by the careful scientific investigator. I should not be willing, after many years' experience with asphalt and a two years' study of Bermudez material, to draw such sweeping conclusions in regard to the two materials as the Philadelphia experts have done from the experience of a few weeks, experts too, who, although known to me personally to be gentlemen of high scientific ability, I have never heard of before as being in any way associated or having had any experience with the asphalt question.

In conclusion, I do not wish to be considered as an advocate of Trinidad asphalt as preferable to Bermudez. The merits of the two asphalts are still under investigation and must be settled chiefly by the lapse of time. Experience has shown us that asphalt pavements can be made with Trinidad Lake pitch which will last for years. This may be the case with Bermudez asphalt, but it has not been proved.

Under what conditions Trinidad or Bermudez asphalt pavements can be, or are, laid in Philadelphia, I am at present unacquainted. I have written to you in order that the statements in the report which I have reviewed, which might do a great injury to a well established industry, should not remain unchallenged. I trust that you will take my statement in the spirit in which it is intended. Very truly yours,

Clifford Richardson,
Washington, D. C., June 13, 1894. Chemist.

WATER-JET PROPULSION ON THE RIVER ELBE, GERMANY.*

(With inset.)

The Elbe River Navagation Co. has made extensive experiments recently with a turbine propeller with a "contractor," invented by Professor Zeuner, of Dresden, which have given interesting results. The propulsion of ships by water jets had been proposed by Rumsey, an American, towards the end of the last century and was elaborated and practically tried in England by Ruthven and in Germany by Seydel during the '50's. In the Ruthven construction, Fourneyron radial turbines, actuated by steam engines, draw water through openings in the ship's bottom and eject it under high pressure through tubes located under water outside and parallel to the ship sides, the orifices of which point opposite to the direction of the vessel. The results thus obtained had been inferior to those of screw propellers or paddle wheels, and Zeuner has for many years been investigating the causes of the failure of the old constructions. He believes now that the system of water-jet propulsion can be made a success, if the curves of the pipe conduits be avoided, if the water be made to enter the ship in the same direction in which it leaves it, and if, finally, at a normal speed, the water enters without shock and is carried through the apparatus without sudden changes of speed or direction. Starting from this basis Zeuner has devised the following system: A Henschel-Jonval axial turbine is placed at the stern of the ship in lieu of the screw propeller, acting as a pump and forcing the water from the outlet of the guide casing. Fig. 1 shows a longitudinal section of the apparatus. A is the running wheel of the turbine, driven by the engine shaft B. The blades of the fixed guide casing C divert axially the water which has passed the running wheel and which is gradually contracted into a solid stream in the "contractor" C. The dimensions chosen are such that the water leaves the outlet at a speed considerably greater than that at which it passed

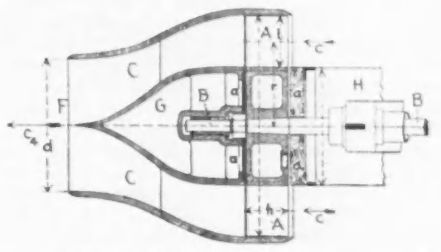


Fig. 1. Vertical Section of Zeuner Turbine Propeller.

the turbine. Fig. 2 shows the curves of the blades S_1 and S_2 corresponding to the developed surface of a cylinder of the radius r. If w is the speed of circumference for the radius r, the blade angles a_1, a_2, a_3 must be so chosen that at a given speed, c, the water will enter the turbine wheel and strike the guide blades without shock. The pressure of the water will be uniform until the water reaches

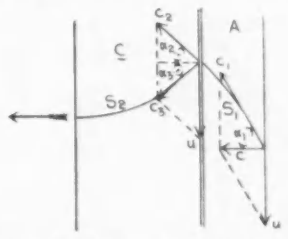
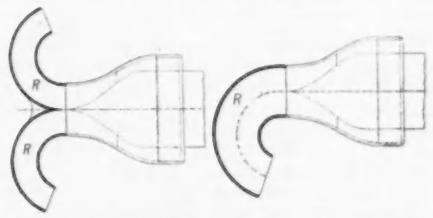


Fig. 2. Diagram Illustrating Action of Turbine.

the "contractor," in which it will be increased in a way dependent on the chosen dimensions. To this increase is due the acceleration of the water towards the orifice of the contractor.

The ship is given a backward motion by dropping a curved tube, R, before the outlet of the contractor, diverting the water to the right and left in the case of one turbine at the stern, Fig. 3, or diverting it in one direction only, Fig. 4, if there are



Figs. 3 and 4. Devices for Backing a Vessel with Turbine Propeller.

twin propellers. In the latter case the ship can be turned by dropping the tube on one side only. In order not to retard the vessel when moving, the curved tube is normally kept held in a position above the water level, or, if the propellers are at the sides of the ship, the curved tubes rest in a recess on the side of the vessel. It will be noticed that as the vessel is given a backward motion in the manner above described, reversing the engine driving the turbine is never necessary. By the dropping or lifting of the tube the motive power is reversed almost instantaneously and without shock to the engines or vessel.

Many different locations may be chosen for the propeller, which may be either inside or outside of the ship and may be greatly varied as to its constructive details. The propeller may even be placed partly above the water level, if only a hood over the inlet of the tube makes the water enter below it, and so prevents the entrance of air. This makes

* Translated by W. G. Triest, Jun. Am. Soc. C. E., from a paper by C. Busley in the "Zeitschrift des Vereines Deutscher Ingenieure."

the propeller especially suitable for light draft vessels.

Results of Trials.

The Elbe River Navigation Co. has equipped with the Zeuner turbine propeller the three steamers "Elbfee," "Amsel" and "Sachsen" intended for navigation on the Elbe. The "Elbfee," which has a length on the water line of 41 ft., a width of 7¼ ft. and a mean draft of 29½ ins., was built originally with a three-bladed propeller of 27 ins. diameter, driven by a high-speed compound engine. Trials were first made with the propeller to allow future comparison. The screw was then taken off the shaft and replaced by a turbine propeller with contractor. To approximate the number of revolutions of the shaft, 360 per minute, the dimensions of the turbine had to be changed, necessitating a deviation from its most favorable proportions. The resistance of the vessel, steaming against the current, was calculated to be 440 lbs. for the required speed of 8.95 miles per hour, and the propeller was accordingly made with the following dimensions:

Mean radius of running wheel $r = 8\frac{5}{8}$ ins.
Radial width of running wheel $l = 5\frac{1}{4}$ ins.
Height of running wheel $h = 4\ 5\text{-}16$ ins.
Diameter of contractor orifice $d = 13\frac{5}{8}$ ins.
Number of blades in wheel, 20.
Number of blades in contractor, 16.
Angles of blades $a_1 = 60°$, $a_2 = 43°\ 30'$, $a_3 = 40°\ 30'$.

The relative axial velocity of the water, c, in entering was taken as 8.95 miles, giving a final speed, c3, of 15.66 miles, and 300 revolutions of the turbine per minute, at which speed 23 cu. ft. of water are calculated to pass the apparatus per second.

The trial trips gave the following results:

Propeller.		Speed, miles hour.	Boiler pressure, lbs. sq. in.	Minimum revolutions.	Indicated H. P.
Screw	down stream.	10.785	146	355	25.64
	up stream....	6.196	142	358	24.76
	mean.....	8.489	...	...	24.70
Turbine with contractor	down stream.	11.252	147	302	22.55
	up stream....	6.398	150	304	22.55
	mean.....	8.825	...	...	22.55

Experiments with a model of the "Elbfee," made one-fifth of full size, proved the resistance to be 484 lbs., instead of 440 lbs., as calculated; but it was not thought advisable to increase the diameter of the wheel, as this would have necessitated a reduction of the number of revolutions, which was undesirable on account of the engine being already installed.

The other two steamers were designed for jet propulsion when originally laid down. The dimensions of the "Amsel" are:

Length on water line.....38.6 ft.
Beam ..... 8.2 "
Draft ..... 1.6 "

The turbine propeller was calculated from the dimensions of that used in the "Elbfee." A balanced rudder is used, with its plane in the axis of the propeller. It manoeuvres the ship very easily, as the full power of the water jet strikes its face when it is turned. The contract speed of the vessel is 7.83 miles in 6½ ft. of water.

The steamer "Sachsen," built for the Saxon Government, has the following dimensions:

Length on waterline.....110 ft.
Beam ..... 12¼ "
Draft ..... 25½ ins.

The two turbine propellers, one on each side about midships, have been calculated for a speed in deep, still water of 12.3 miles an hour, the vessel's resistance having been ascertained to be 2,680 lbs. Their dimensions are:

Mean radius of running wheel, $r = 9\frac{7}{8}$ ins.
Radial width of running wheel, $l = 5\frac{7}{8}$ ins.
Height of running wheel, $h = 5\frac{7}{8}$ ins.
Diameter of contractor orifice, $d = 15\frac{1}{4}$ ins.
Number of blades in running wheel, 20.
Number of blades in guide passage, 13.
Angles of blades $a_1 = 48°\ 50'$ $a_2 = 0°$ $a_3 = 49°\ 40'$.
Minimum number of revolutions, 240.
Water delivered by each propeller per second, 40 cu. ft.

The contract speed was fixed at 11.2 miles per hour for a mean depth of the river. During a trial trip at a high stage of the river she made 15.8 miles downstream and 7.78 miles upstream, or an average of 11.79 miles.

(We have discussed the general subject of jet propulsion in our editorial columns and have commented there on the statements and figures in the above article.—Ed.).

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BANGOR & AROOSTOOK.—Moses Burpee, Ch.Engr., Houlton, Me., writes us that the principal contractor for the work noted last week is C. P. Treat and that subcontracts have already been awarded to A. E. Trites, W. O. Johnson, J. McLaughlin, McQueen & Stewart, McPhail Bros. and Malcolm & Ross.

BUFFALO & SUSQUEHANNA.—The advisability of extending this road from Cross Forks down Kettle Creek to Westport, Pa., is being considered.

LOUISVILLE, EVANSVILLE & ST. LOUIS CONSOLIDATED.—Bids are asked until June 30 for excavation over roof of Patton tunnel near Taswell, Ind., and lining 500 ft. of tunnel as previously stated in advertising columns. This is an extension of time from June 20. I. A. Allen, Ch. Engr., Evansville, Ind., writes us that all bids will be submitted to the receivers as soon after June 30 as possible and that bidders are not expected to be present in person but will submit sealed bids by mail to the chief engineer.

MIDDLESEX VALLEY.—Press reports state that the contract for building an eight-mile extension of this road, to connect with the Lehigh Valley at Torrey Park, N. Y., has been awarded to John J. Dolan. The roadbed is said to have been graded 21 years ago.

MONTFORD COLONIZATION.—The "Railway Review" states that surveys have been made for about 25 miles of this railway and a few miles have been graded. The route is from a junction with the Montreal & Western near St. Sauveur, Que., to the Ottawa & Gatineau Valley. The total length of the projected road is 154 miles. The company employs its own forces, and has at present 500 men on the construction work. About 12 miles of track has been laid from St. Sauveur toward Lachute, on the Canadian Pacific. The officers of the company are as follows: Pres., Eusebe Senecal; Secy., A. S. Hamelin; Ch. Engr., H. H. Dupont; principal office, 218 St. Lawrence St., Montreal.

PENNSYLVANIA.—The 90 days granted this company in which to commence the construction of the Elkton, Middletown & Massey's road, in Maryland, have about expired and it is expected that the grading will soon be commenced. The route has been located, according to the Baltimore "Sun," as follows: The new line will parallel the main tracks of the Pennsylvania from Elkton Station north for a short distance, then, curving east and south, will pass through East Elkton, and will then run in the most direct line possible to a point on the Delaware & Chesapeake canal within a quarter of a mile of Chesapeake City, thence to a point near St. Augustine, where the line will divide, one branch going to Middletown and the other to Massey's. The report further states that this company will operate the Elkton & Southern, Baltimore & Delaware Bay, Easton & Chestertown, and such other lines as may be included in the projected trunk line down the Maryland peninsula.

PENNSYLVANIA MIDLAND.—Press reports state that an agreement of consolidation has been executed between the Bedford & Somerset R. R. Co., Brooks Mills & Altoona R. R. Co., Mann's Choice & Hyndman R. R. Co., and Bedford & Blair County R. R. Co., and a new company organized with the above name. Pres., Geo. B. Oriady, Huntingdon, Pa.; Secy., S. J. Spyker, Huntingdon, Pa.; Treas., W. Grant Wilson, Harrisburg, Pa. The road will extend from Hyndman to Altoona, Pa., and taps valuable coal and mineral lands in Bedford and Somerset counties. Laborers are now engaged in the preliminary construction. The contract for the construction of the Bedford & Blair County road was recently awarded to E. A. Tennis, Thompsontown, Pa., and it is stated that about 300 men are at work on the grading.

WISCASSET & QUEBEC.—Press reports state that the construction of this narrow gage railway in Maine is being actively pushed. Pres., Geo. H. Crosby, Albion, Me.

Projects and Surveys.

EASTON & CHESTERTOWN.—Incorporated at Centreville, Md., to build a railway from Easton to Queen Anne's station, thence to Centreville and Church Hill, terminating at Chestertown, Md. It will nearly parallel the Queen Anne & Kent branch of the Philadelphia, Wilmington & Baltimore. This is said to be in the interest of the Pennsylvania; capital stock, $500,000; Geo. E. Haddaway, W. Goldsborough, of Easton, Md.; Jas. A. Pearce, Chas. T. Wescott, Chestertown, Md.; P. H. Teddeman, Centreville, Md.

Southern—Existing Roads.

CAPE FEAR & YADKIN VALLEY.—It is stated that the plan for reorganization will provide for an extension to Southport, N. C., 23 miles. Ch. Engr., H. L. Fry, Greensboro, N. C.; Receiver, Gen. John Gill, Baltimore, Md.

CHARLESTON, CLENDENIN & SUTTON.—This railway has been in operation from Charleston to Clendenin, W. Va., 20 miles, for about a year, and it is stated that arrangements have been completed for extending the line up Elk River to Sutton. J. Wainwright and Charles Young, Pittsburg, Pa., are interested.

KANAWHA & COAL RIVER.—A meeting of the stockholders will be held June 25, according to reports, to authorize an issue of $150,000 in bonds for extensions and improvements. Supt., A. M. Wooldredge, Spring Hill, W. Va.

Projects and Surveys.

COLBERT SHOALS & WESTERN.—Incorporated in Alabama to build a railway from the south bank of the Tennessee River in a southwesterly direction to the Mississippi state line; capital stock, $50,000; E. Reynolds, Jr., Wynne, Neb.; C. W. Hammond, Louisville, Ky.; C. W. Shurin, R. A. Abernethy, Tuscumbia, Ala.; S. E. Philps, Denver, Colo.; T. N. Roulhair, J. H. Walton, Sheffield, Ala.

FRENCH CREEK & LITTLE KANAWHA.—Organized in West Virginia to build a railway from Hampton, Upshur county, on the West Virginia & Pittsburg, to Bodkin Springs, according to reports.

KENTUCKY.—Concerning the projected road noted under this heading on June 7, John C. C. Mayo, Paintsville, Ky., writes as follows to the "Railway Age": The contract reported let to Wolfe & King, Duluth, for building the railway from White House to Elkhorn, was simply a conditional contract and will result in little or nothing, owing to the death of Mr. Wolfe, who was largely interested. We have made large purchase of coal lands in Johnson, Floyd and Pike counties and intend to begin construction within a reasonable length of time, but at present we have no definite arrangement as to immediate work.

LEESBURUG, EMERALDA & NORTHERN.—Organized to build a railway from Leesburg, Fla., north to Emeralda, 13 miles; Pres., R. L. Anderson, Oscala, Fla.; Ch. Engr., C. S. Noble, Leesburg, Fla.

ROCK LEDGE RY. & IMPROVEMENT.—It is stated that this company, of Rock Ledge, Fla., will build about ten miles of railway.

Northwest—Existing Roads.

ARNAPEE & WESTERN.—E. Decker, Pres., Ahnapee, Wis., writes us that this road is in operation from Casco Junction to Ahnapee, Wis., 14 miles, and that the extension north to Sturgeon Bay, 20 miles, will be finished and in operation the latter part of July. About eight miles of the track have been laid and over 200 men are now working on the line.

BRAINERD & NORTHERN MINNESOTA.—A press report from Minneapolis states that the Nelson-Tenney Lumber Co. has contracted with Foley Bros. & Guthrie, St. Paul, for the construction of an extension of this road 41 miles in length and that the work will be commenced at once.

BURLINGTON & MISSOURI RIVER.—I. S. P. Weeks, Ch. Engr., Lincoln, Neb., writes us that ten miles of track has been laid from Alger, Wyo., on the extension to Billings, Mont., and that the line will probably be opened for traffic Sept. 15, 1894. Kilpatrick Bros. & Collins, Beatrice, Neb., have over 1,000 men at work on the line. The official name of this extension is the Grand Island & Northern Wyoming, 20 miles, and the Big Horn Southern, 101 miles, in Montana.

FREMONT, ELKHORN & MISSOURI VALLEY.—Press reports state that this road will be extended this summer from Belle Fourche, S. Dak., to the Hay Creek coal fields, for which surveys are now being made, and that the company is considering the advisability of an extension north to a connection with the Northern Pacific at Miles City, Mont.

RED RIVER VALLEY & WESTERN.—It is stated that the Great Northern has secured possession of this road and has filed papers authorizing an extension through Cass, Parnes and Stutsman counties, in North Dakota, to the James River.

Projects and Surveys.

HAMDEN & WATERPORT.—It is stated that this road will be built as far as Frankfort, Ill., this season. Address Gen. Henry L. Mitchell, Hamden, Ill.

HARLAN, SIOUX CITY & NORTHERN.—Incorporated in Shelby county, Iowa, to build a railway from Harlan north to connect with the Sioux City-Chicago road.

LAKE SUPERIOR, IOWA & GULF.—Incorporated at South Sioux City, Neb., to construct a railway from the state of Nebraska to Lake Superior. This is a local feature of the Gulf & Interstate project and press reports state as follows concerning it: There are some remarkable features of the articles of incorporation. The company has the authority to sell bonds, to which there shall be attached coupons that may be taken in payment for transportation of freight or passengers over the line. The roadbed and all appurtenances are to pass into the control of the state as soon as the state shall pass a law for state control of railways, and is to be maintained forever by the state for the free use of all lines of road or individuals that may desire to use it. All earnings of the line in excess of expenses are to go to the state school fund. The company expects to raise money for building the line from the farmers and business men along the route. The incorporators include the leading Populists in this section.

NORTH DAKOTA.—D. W. Huris, Cavalier, N. Dak., is reported as interested in a railway from Cavalier to Drayton, N. Dak., a distance of 40 miles, for which surveys are now being made.

ST. LOUIS, GRAND TOWER & SOUTHERN.—It is reported that contracts have been awarded for building this railway, in Illinois, as follows: East St. Louis to Chester, John Scott; Chester to Grand Tower, McCabe, Penny & Meyers; Grand Tower to Cairo, Tansey & Ware; tracklaying, M. English; ties and bridge lumber, Robinson & Mars; bridging, Carter Bros.

Southwest—Existing Roads.

SAN ANTONIO & GULF SHORE.—The grading on this road is reported as progressing rapidly and it is expected that 20 miles will be ready for the track by July 1.——The stockholders have authorized Wm. Davis, Pres., to bond the main line, from San Antonio to Velasco, for $12,000 per mile.

STATE.—L. W. Wells, Ch. Engr., Tyler, Tex., writes us that 250 men and 20 teams are at work on this railway from Rusk, Tex., to a connection with the International & Great Northern, about 30 miles. The work is being done by convict labor under the supervision of the superintendent of the state penitentiary. About two miles of track have been laid, five miles of grading completed and ten miles of the road located. The road is projected in the interest of the penitentiary iron industries. The line is through a rough country; 1% grades and 4° curves. There will be a bridge across the Neches River.

Projects and Surveys.

ARKANSAS NORTHWESTERN.—Incorporated to build a railway from Bentonville, Ark., in a northwesterly direction to a point on the Arkansas-Missouri state line, a distance of 25 miles; capital stock, $300,000; Jos. Hansen, H. M. Hansen, H. C. Hull, F. C. Parker, T. J. Porter, S. F. Stahl, L. H. McGill, J. A. Rice, C. L. Robinson and J. H. Robart.

Rocky Mt. & Pacific—Existing Roads.

MARICOPA & PHOENIX.—Press reports state that an extension will be built from Tempe to Mesa, Ariz

Projects and Surveys.

OREGON.—Press reports state that surveys are being made for a motor line between Albany and Sodaville, in this state.

STREET AND ELECTRIC RAILWAYS.

HAMPDEN, ME.—The Hampden & Winterport Ry. Co. has secured the right of way to build an electric line, and it is stated that the construction will be commenced this month.

BROOKLYN, N. Y.—The Long Island Electric Railway Co. has been formed to build a line from the limits of Brooklyn, through Jamaica, on a route parallel with the Long Island R. R.; capital stock, $600,000; Pres., A. R. Hart; Treas., Clarence Wolf, Philadelphia, Pa.; Secy., J. C. Van Arx.

BUFFALO, N. Y.—J. J. West & Co., Johnsonburg, has been awarded the contract for constructing an electric railway to Sanborn, at about $60,000, according to reports.

MIDDLETOWN, N. Y.—The Middletown-Goshen Traction Co. has been granted a franchise for an electric railway through Benton Ave.

NORTH GREENBUSH, N. Y.—The town board is considering the granting of a franchise to the Troy & Sandlake Electric Ry. Co. to build a line through this place.

WHITE PLAINS, N. Y.—The committee has recommended the granting of a franchise to the New York, White Plains & Mamaroneck R. R. Co., for an electric railway.——A company, consisting of S. L. H. Ward, E. C. Sniffin, John Duffy, S. Gainsboro, and others, is reported as about to ask for a franchise to build a line from Elmsford through this place to Mamaroneck.

NEWARK, N. J.—The North Jersey St. Ry. Co. has been incorporated; capital stock, $5,000,000; incorporators, J. K. Corbiere, Caldwell; D. V. Harrison, W. H. Power, Montclair; J. C. Beach, H. M. Barrett, Bloomfield. Press reports state that the first line to be built will be an electric road from the terminus of the Consolidated Traction Co.'s line in Bloomfield Ave., Bloomfield, to Caldwell. Other lines will be built in the suburbs, and the system will finally reach to Morristown.

CARLISLE, PA.—The Cumberland Valley Traction Co. has purchased the franchise of the Harrisburg & Mechanicsburg Electric Ry. Co. for about $75,000, and it is reported the line will be extended to Mount Holly and Boiling Springs.

PHILADELPHIA, PA.—The Philadelphia & Trenton St. Ry. Co. has been incorporated to build a line 25 miles long; capital stock, $130,000; Pres., L. Calvin Mans; J. H. Reall, Bloomfield, N. J.——The Roxborough, Chestnut Hill & Norristown Traction Co. has been incorported; capital stock, $5,000; Treas., H. C. Esling.——The Pennsylvania Traction Co. has completed surveys for its proposed electric railway between this city and West Chester.

BALTIMORE, MD.—The Baltimore & Harford Turnpike Co. has granted a franchise to the City Passenger Ry. Co. for an electric railway on the turnpike.

BOONSBORO, MD.—The county is to be petitioned to assist in completing the building of the South Mountain Electric Ry. from this place to Keedysville. It is thought that the road can be completed for $25,000.

KENSINGTON, MD.—It is reported that a company is being formed to build an electric railway from Chevy Chase to this place, and probably to Sandy Springs.

HAMILTON, O.—An effort is being made to have the proposed electric railway between this place and Cincinnati change part of the route so as to pass through Venice and Millville.

LORAIN, O.—The Lorain St. Ry. Co. has been reorganized with the capital stock increased from $40,000 to $100,000. A contract has been awarded to the Johnson Co., Johnstown, Pa., to construct and equip the line. Pres., W. F. Bien; Secy. and Treas., Frank Horan.

PAINESVILLE, O.—The Painesville,Fairport & Richmond St. Ry. Co. nas increased its capital stock from $50,000 to $150,000.

ELWOOD, IND.—The Elwood Electric St. Ry. Co. proposes to issue bonds for $50,000 to extend its line to Frankton, according to reports.

FREEPORT, ILL.—B. J. Arnold, The Rookery, Chicago, has been engaged as consulting engineer for the new electric railway. Kohler Bros., The Monadnock, Chicago, have been awarded the contract for the motors, generators, and cars. L. E. Myers, The Monadnock, Chicago, has the contract for the track and overhead work.

MILWAUKEE, WIS.—A line is projected to North Greenfield, and steps are now being taken to secure a franchise by Mr. Wyman, Gen. Man. Milwaukee Electric Ry. Co.

ST. LOUIS, MO.—The St. Louis county court has granted franchises to the following electric railway companies: The Kirkwood & St. Louis R. R. Co., contract for constructing the line has been awarded at $150,000; the Midland Ry. Co., to extend the line to Creve Coeur Lake, and the Clayton & Creve Coeur Ry. Co.——The Lindell R. R. Co. has been granted a permit to erect a power house on Park Ave., to cost $46,000.

WOODBURN, ORE.—The Butte Creek Coal Co. has been incorporated and will construct a tramway; capital stock, $50,000; incorporators, C. R. Hougham, B. F. McLaney and L. H. Tarpley.

SAN FRANCISCO, CAL.—The Market St. R. R. Co. has petitioned for a franchise to extend its line along 10 streets.

ST. JOHN, N. B.—The St. John Electric Ry. Co. has been organized. Pres., Wm. Van Horne, Montreal, Que.; directors, Jas. Ross, Montreal; J. J. Tucker.

PORT ARTHUR, ONT.—Bids are asked until July 2 for the leasing of the Port Arthur Electric St. Ry. for a term of 20 years. The line is 7½ miles long and operates between this place and Fort William. W. H. Langworthy, Cy. Clk.

HIGHWAYS.

MASSACHUSETTS.—The park commissioners of Boston have submitted a plan to the Malden council for building a boulevard through that city to Middlesex Falls; estimated cost, $500,000.

CONNECTICUT.—W. H. Olmstead, Engr., East Hartford, writes us that a contract for 11,500 sq. yds. of macadam road has been awarded to J. S. Lane & Son, at $13,000.

NEW JERSEY.—G. W. Howell, Surv. Morris County, Morristown, has been directed to make surveys and estimates for grading and macadamizing 182 miles of the main roads. It is probable that $300,000 of 4% bonds will be issued.

OHIO.—The commissioners of Cuyahoga county have decided to buy the franchise of the Rockport & Dover Turnpike Co.'s road for $9,000, and a new road will be opened from Olmsted Falls to the turnpike.

BRIDGES AND TUNNELS.

BOSTON, MASS.—A committee of the city council has been investigating the bridges in other cities preparatory to accepting plans for another large bridge to be built in this city.

PROVIDENCE, R. I.—Both branches of the General Assembly have passed a bill providing for the construction of a new iron or steel bridge over the Seekonk River, between this city and East Providence, upon the site of the present red bridge, and appropriating $40,000 toward its construction.

NIAGARA FALLS, N. Y.—The city clerk has been ordered to advertise for a special election on the proposition to raise $8,000 for a new bridge on Second St. ——A contract for a stone-arched covered bridge across the canal, for carrying electric cables, etc., has been awarded to Jas. Stewart & Co., at about $7,000.

JERSEY SHORE, PA.—Bids are asked until July 3 for constructing a bridge at Allegheny and Railroad Sts.

PHILADELPHIA, PA.—President Cleveland has approved the bill authorizing the construction of an iron bridge over the Delaware River at this place.——It is stated that the director of public works will ask for bids within a few days for the construction of the Falls bridge, estimated to cost about $300,000; the Wyoming Ave. bridge, about $50,000, and the Torresdale Ave. bridge, about $60,000.

CAMBRIDGE, MD.—The following bids were received last week for the 137-ft. iron drawbridge across Cambridge Creek at this place; the bridge to have two openings, each with a clear width of 50 ft.; Engr., Chas. H. Latrobe, Baltimore; Superstructure—Toledo Bridge Co., $4,299; Groton Bridge & Mfg. Co., $4,840; Youngstown Bridge Co., $4,743; King Bridge Co., $4,590; Delaware Construction Co., $6,630; Wrought Iron Bridge Co., $5,900. Substructure—Benjamin Glenn, $5,844; Andrew Brown, $5,408; Delaware Construction Co., $4,975.

MURPHY, N. C.—Bids are asked until July 1 for the construction of a double track bridge, with sidewalk, for Cherokee county. W. M. West, Chn.

AUGUSTA, GA.—There were 11 bids received for building the new iron bridge at Greene and 15th Sts., ranging from $4,000 to $6,000; the bidders, according to press reports, being as follows: Groton Bridge & Mfg. Co., Groton, N. Y.; F. C. Austin Co., Chicago; Youngstown Bridge Co., Youngstown, O.; Iron Superstructure Co., Columbus, O.; Grant Wilkins, Atlanta; Milwaukee Bridge Co., Milwaukee, Wis.; King Bridge Co., Cleveland, O.; Converse Co., Chattanooga, Tenn.; George H. Crafts, Atlanta; American Bridge & Iron Co., Roanoke, Va.; M. O. Bellingrodt, Augusta.

CLEVELAND, O.—Bids are asked until July 12 for rebuilding the masonry substruction and approaches for the Columbus St. bridge over the Cuyahoga River. J. H. Farley, Dir. Pub. Wks.——The county commissioners have decided to locate the new high level bridge over Rocky River at Stranahan's Crossing instead of at Mastick's Run.——The Cleveland, Lorain & Wheeling R. R. Co. is reported as securing estimates for replacing 56 wooden bridges with steel bridges, at an estimated cost of $62,000. It is stated that when this work was contemplated three years ago the lowest estimate was $122,000. Ch. Engr., W. B. Hanlon, New Philadelphia, O.; Gen. Man., W. R. Woodford, Cleveland.

DAYTON, O.—The county commissioners are considering the location of a new bridge north of this city.

TOLEDO, O.—The county commissioners are reported as about to rebuild the bridge at Norton's Corners, Oregon township.

JEFFERSONVILLE, IND.—The county commissioners have decided to build a bridge across Blue Lick Creek, on the Salem road, near Henryville, according to reports.

DUNDEE, MICH.—Bids are asked until June 23 for constructing a bridge over the Macon River, according to reports. Wm. F. Lafler, Comr.

LANSING, MICH.—The Wrought Iron Bridge Co., Canton, O., has been engaged to prepare plans for the proposed Michigan Ave. bridge.

LONE ROCK, WIS.—The citizens have subscribed $4,000 toward the construction of a bridge across the Wisconsin River at this place.

AITKIN, MINN.—A press report states that a contract has been made between the county commissioners and Freeman E. Krech, Waren Potter, W.B. Marr, J.J. McDonald, J. N. Marr and F. M. Shook, business men of this place, by which the business men are to build a wagon bridge across the Mississippi River within one year. The commissioners bind the county to pay for the bridge as soon after its completion as funds are available for the purpose. Work will be commenced without delay and pressed to rapid conclusion.

ANOKA, MINN.—The county commissioners have appropriated $3,000 toward a new bridge at St. Francis.

RED WING, MINN.—Bids are asked until July 6 for the superstructure of a bridge over the Mississippi River at this place, as stated in our advertising columns. Engr., Charles F. Loweth, St. Paul; L. P. Wolff, Cy. Engr.

VISCALIA, CAL.—The clerk has been directed to advertise for bids for the construction of approaches to bridge across Tule River between Porterville and Plano.

HAMILTON, ONT.—Efforts are again being made to secure the construction of a swing bridge at the ferry at the Beach; estimated cost, $22,000.

NEW WESTMINSTER, B. C.—Bids are asked until July 31 for the construction of a combined railway and highway iron or steel bridge over the Fraser River. Specifications and blueprints sent for $20. A. M. Herring, Chn. Com.

BRIDGES DESTROYED.—The bridges destroyed during the week include the following: Ten bridges carried away by high water near Wichita, Kan.; all the bridges on the line of the Port Arthur, Duluth & Western R. R. between Port Arthur and the western terminus in Minnesota, and several on the western lines Canadian Pacific. Bridges were destroyed by striking coal miners in the vicinity of Birmingham, Ala., and in Ohio and West Virginia. Two bridges near Nestoria, Mich., on the Duluth, South Shore & Atlantic Ry. were destroyed by forest fires, and a bridge carrying the Hannibal & St. Joseph R. R. across the Charlton River between Callao and New Cambria, Mo., was also burned June 11.

WATER-WORKS.

IPSWICH, MASS. Bids are asked until July 2 for $100,00 of 4% 30-year water bonds.——The water commissioners have contracted with M. J. Drummond, 192 Broadway, New York, for 58,360 ft. of 14 to 6-in. cast iron coated water pipe for the proposed works. The "Globe" specials made by the Builders' Iron Foundry will be used. Freeman C. Coffin, Engr.

LINCOLN, MASS.—Bids are asked until June 25 for the purchase of $20,000 of 4% 20-year water bonds.

METHUEN, MASS.—At an election June 11 it was voted to appropriate $50,000 to complete the works.

NEWBURYPORT, MASS.—The governor has signed the bill authorizing the city to purchase the plant of the Newburyport Water Co., and forbidding the construction of municipal works if the company offers to sell the city its plant.

SPENCER, MASS. It is reported that the commissioners have been instructed to procure plans for a filter.

JAMESTOWN, R. I.—At an election June 9 it was voted to extend the works; also to purchase a steam fire engine, for which $3,500 was appropriated.

NORWICH, CONN.—It is reported that the council has appropriated $27,000 for extensions and improvements.

ALBION, N. Y.—The village is talking of purchasing the plant which is reported as being for sale.

AMITYVILLE, N. Y.—An election is to be held June 26 to vote on an appropriation of $1,000 per year for five years for fire protection. If this is carried the water company will extend its mains and add 40 fire hydrants, according to reports.

CHERRY CREEK, N. Y. F. J. Trusler, Shutairsville, and T. Crary, Binghamton, were in the village last week discussing the question of putting in works.

EARLVILLE, N. Y.—George Bergan, Corporation Clk., writes us that bids are asked until July 6 for putting in works; supply from reservior; population, 1,000.

JAMAICA, N. Y.—It is reported that the board of trustees have let a 5-year contract for a supply to the Jamaica Water Co., and the Woodhaven Water Co., at $20 per year for each fire hydrant.

LOWVILLE, N. Y.—Bids for constructing works were received as follows:

Ryan & Avery, Watertown	$20,648
Richardson & Ferriss, Watertown	20,815
Beckwith & Quackenbush, Herkimer	27,097
Troy Public Works Co., Troy	28,500
Otis & Langyear, New York	29,085
Gallo & Wendell, New York	30,230
James T. Campbell, Lowville	32,901
Cook & Reed, Cleveland	35,000

PENN YAN, N. Y.—Walter F. Randall, C. E. writes us contracts for works were awarded as follows:

Construction, (trenching, pipelaying, reservoir, and intake) Cooke & Read, Cleveland, O.	$21,000
Pumps, Henry R. Worthington, New York	1,200
Boilers, Ames Iron Works, Oswego, N. Y.	1,947
Hydrants, Ludlow Valve Mfg. Co., Troy, N. Y.	2,420
Valves, Eddy Valve Co., Waterford, N. Y.	1,208
Valve boxes, Commercial Iron Wks., Penn Yan	333
Pipe and specials, Lake Shore Fdry, Cleveland.	18,092

SARANAC LAKE, N. Y.—About $30,000 is to be expended to put in works, according to reports.

ASBURY PARK, N. J.—The commissioners have let contracts to the Pohle Air-Lift Pump Co. for an air lift pump to cost about $7,500.

DECKERTOWN, N. J.—Jacob Gould, S. H. Lawrence and others have visited other towns of the state investigating the question of works.

BRADDOCK, PA.—At a meeting of the council of Rankin borough last week it was decided to issue $20,000 in bonds for laying mains.

CORRY, PA.—Potter & Folwell, New York and Pittsburg, are preparing plans for the Corry Gas & Water Co. The present works were built in 1886 by the Corry Water Co., which is said to be composed of New York capitalists.

EAST GREENVILLE, PA.—Horatio Sands, Pottstown, is to prepare plans for works, according to reports.

FACTORYVILLE, PA.—The Factoryville Water Co. will commence work at once on a reservoir to be built on the Oliver Cannon farm, according to reports.

HALIFAX, PA.—It is stated that a company will put in works if the town will pay $300 per year for fire plugs.

MIFFLINBURG, PA.—Efforts are being made to secure works.——The Mifflinburg Water Co. has been incorporated, as noted May 31.

NESCOPECK, PA.—The Nescopeck Water Co. has been incorporated to put in works; directors, F. A. Whitman, C. D. Eaton and others, of Berwick, Pa.

NICHOLSON, PA.—There is talk of putting in new works. The water company asks $35,000 for its plant, which is considered too high.

NORTHUMBERLAND, PA.—S. W. Cooper, Ch. Engr., Millersburg, writes us that the Northumberland Water Co. is about to contract for constructing its plant; gravity supply from reservoir four miles distant; population, 3,000. The town will pay $900 per year for 33 fire hydrants for five years.

PHOENIXVILLE, PA.—The board of health has urged the putting in of a filter plant, estimated to cost $10,000.

READING, PA.—The city engineer has been directed

to prepare plans for increasing the capacity of the Edelman reservoir; also for raising the wing wall and breast of the Bernhart dam.

DOWNINGTON, PA.—An election is to be held to vote on borrowing $30,000 to construct new works. The town has works controlled by a company, but the citizens have become dissatisfied with the service.

WAPWALLOPEN, PA.—The Citizens' Water Co. has been incorporated to supply this village with water; capital stock, $2,500; Treas., A. B. Karchner.

WILKES BARRE, PA.—The council has passed an ordinance providing for a system of filtration.

WERNERSVILLE, PA.—It is reported that a company is investigating the advisability of putting in works. E. S. Hassler is interested.

BALTIMORE, MD.—The county commissioners are talking of securing a reservoir in Highlandtown for additional fire protection. Chas. B. McClean, County Surv.

ELLICOTT CITY, MD.—Jas. E. Vansant, Registrar, writes us that D. G. Adelsberger, 400 N. Paca St., Baltimore, is preparing plans for works, and that an election may be held next month to vote on the question of issuing $30,000 in bonds for the construction.

QUITMAN, GA.—At an election June 11 it was voted to issue $20,000 in 6% bonds for putting in works and an electric light plant, the contracts for which have already been awarded.

ROME, GA.—The council of North Rome has awarded a contract for laying 1,000 ft. of mains, to A. W. Walton & Co.

ALEXANDRIA, LA.—It is reported that bids are asked for putting in works.

THIBODEAUX, LA.—H. N. Coulon, Clk. Town Council, writes us that a tax for works was voted on June 18, and if carried the works will probably be put in as soon as possible.

NASHVILLE, TENN.—The penitentiary building committee is preparing to build a reservoir near the main prison site below the city.

DANVILLE, KY.—E. W. Smith, Res. Engr., writes us that the contract for a complete system was awarded to Howard De Long & Co., Lexington, at $66,000; about 75 bids were received. Material to be used: Pumping machinery, Nordberg Pumping Engine Co., Milwaukee; pipe, Dennis Long & Co., Louisville; stand-pipe, Armstrong & Co., Springfield, O.; filter, New York Filter Co., New York; Crane or Ludlow hydrants.

MORGANFIELD, KY.—Collins Walter, Clk., writes us that surveys are being made for works; supply from wells; population, 1,800. For further information address Sanders & Porter, Louisville, Ky.

ASHLAND, O.—C. G. Ducomb, Cy. Clk., writes us that an election will be held to vote on the question of issuing $45,000 in bonds for constructing works.

BELLEVUE, O.—Bids are asked until July 2 for $12,000 of bonds for a stand-pipe and extensions. W. H. Dimick, Clk.

DAYTON, O.—Bids are asked until June 25 for laying service pipes in about seven streets. C. A. Herbig, Cy. Comptroller.

WAPAKONETA, O.—The council is considering the advisability of granting a franchise.

ZANESVILLE, O.—Bids are asked until July 14 for constructing a 25 × 100-ft. or a 25 × 85-ft. steel stand-pipe.

LAFAYETTE, IND.—The contract for extending the works to the West Side has been awarded to J. D. Heaton, Junction City, Kan., at $38,675.

CALUMET, MICH.—At a meeting of the council June 7 it was decided to extend the works.

MARION, MICH.—The Clark Water Co. has been organized to put in works.

DOWNER'S GROVE, ILL.—Bids are asked until July 9 for 8 to 12-in. pipe, 30 hydrants, etc., as stated in our advertising columns. Engr., W. S. Shields, 100 Washington St., Chicago.

MORRIS, ILL.—The question of works is being discussed; estimated cost, $15,000 to $25,000.

SIDELL, ILL.—It is reported that the village has voted in favor of works.

VIRDEN, ILL.—The citizens have subscribed $1,000 of the $2,000 demanded by the parties contemplating putting in works.

WAUKEGAN, ILL.—H. W. Large, Engr., writes us that a special assessment of $70,500 has been levied for new works. Plans will include a crib in Lake Michigan, 4,000 ft. of 24-in. intake pipe, new power house, pumping machinery, settling well and a distribution system of 16, 12 and 6-in. mains. Plans are now being made and bids will be advertised for by July 1. Consult. Engr., Geo. W. Sturtevant, Jr., Chicago.

WAUKEGAN, ILL.—Bids are asked until July 5 for constructing a complete system of works, as noted in our proposal columns. Consult. Engr., Geo. W. Sturtevant, 804 Chamber of Commerce Building, Chicago. Henry Thacker, Cy. Clk.

EDGERTON, WIS.—Henry Johnson, Cy. Clk., writes concerning works, noted June 7, that the city will grant a 30-year franchise, reserving the right to purchase the works at the end of the first ten years, and at each succeeding five years.

IRON RIVER, WIS.—It is reported that the town has voted to issue $20,000 in bonds for purchasing and extending the works.

KENOSHA, WIS.—E. G. Hazleton, Supt. Kenosha Water Co., writes us that there are no prospects of any proposed extension being made this season; population, 7,000.

SHAWANO, WIS.—The village is reported as desiring to change its charter so as to put in works and electric lights.

SHULLSBURG, WIS.—It is reported that the question of works is being investigated. Address C. O. Brewster or J. B. Simpson.

WAUKESHA, WIS.—The officers of the Waukesha Water-Works Co. are considering plans for important improvements.

WAUWATOSA, WIS.—The citizens are trying to have the mains from Milwaukee extended to this village.

ALTA, IA.—G. A. Proctor, Recdr., writes us that the council has been authorized to issue bonds for works; supply from wells; population, 900. Engr., C. F. Loweth, St. Paul, Minn.

BELLEVUE, IA.—Bids are asked until July 9 for constructing works, as stated in our advertising columns. Consult. Engr., M. Tschirgi, Dubuque; Wm. G. Stuart, Cy. Clk.——Bids are asked for the purchase of $100,000 of 5% bonds. S. L. Baker, Mayor.

CHEROKEE, IA.—At a meeting of the council June 10 the water committee was authorized to investigate the question of a larger and purer supply. The present supply is from a well.

COON RAPIDS, IA.—Bids are asked until June 23 for constructing works. J. C. Manning, Town Recdr.

FORT DODGE, IA.—D. A. Weller, Cy. Clk., writes us that C. F. Loweth is making plans for improvements, estimated to cost $16,000. Address W. L. Pray.

INDIANOLA, IA.—At an election on June 5 it was voted to issue $10,000 in bonds for the construction of works.

KINGSLEY, IA.—J. A. Ingalls, Recdr., writes us that the contract for constructing works has been awarded to the Howe Pump & Engine Co., Indianapolis, Ind., at $5,553.

PELLA, IA.—John Faassen, Cy. Clk., writes us that the city is contemplating putting in works chiefly for fire protection, and that a committee has been appointed to prepare plans and investigate cost of same; a tank or stand-pipe will probably be erected; supply from wells; population, 3,000.

ALBERT LEE, MINN.—The council has voted to ask for bids for 7,000 ft. of extensions, with hydrants, etc.

MINNESOTA LAKE, MINN.—Thos. M. Keogan, Recdr., writes us that the contract for constructing works was awarded to the U. S. Wind Engine & Pump Co., Batavia, Ill., at $4,500.

BERTRAND, NEB.—F. J. Bolen, Village Clk., writes us that no steps have as yet been taken to put in works.

COLUMBUS, NEB.—Press reports state that a contract to sink 30 wells for a supply has been let to Hammond & Young, Schuyler.

FREMONT, NEB.—A contract for extensions has been awarded to the Fremont Foundry & Machine Co., at $5,440. Other bids received were as follows: F. L. Burrell, Fremont, $5,640; Crawford & Wolz, Wahoo, wells, $1,175; Cook Well Co., St. Louis, Mo., wells, $1,375.

HEBRON, NEB.—The contract for new pump house and removing boiler and machinery has been let to Wm. Wood, Hebron, at $991; new well under construction in charge of F. L. Burrell, Engr., Fremont.

NORTH BEND, NEB.—It is reported that the question of putting in works is being agitated.

STERLING, NEB.—Jas. Livingston, Cy. Clk., writes us that the question of works has been dropped, owing to the probable cost; population, 1,000.

HELENA, MONT.—Bids for constructing works at Fort Harrison were received as follows:

Kansas City Bldg & Construction Co.	$22,555
Adams & Rider	20,738
F. F. Fleming	21,266
D. P. Wortman, Helena	17,446
Vidas & Co.	22,994
Wm. T. Semper	25,967
J. P. Courtney	20,875
Twohy & Wells	22,752
Fredk. Yungren	20,886
F. J. Shaner	22,918
Walker & Aitchison	22,919
Gould Bros.	22,104
H. Kirkendall	19,474
J. A. Shoemaker	25,421
Sturrock & Preuitt	28,424

BETHANY, MO.—W. S. Wightman, Cy. Clk., writes us that A. A. Cassil, Engr., will soon have plans and specifications completed for a $30,000 water-works and electric light plant; supply from wells; plans will include stand-pipe and about five miles of mains; population, 2,000.

BRUNSWICK, MO.—W. H. Finch, Clk., writes us that a contract for constructing works and an electric light plant has been let to the Franklin Electric Co., Kansas City, at $10,600.

SALISBURY, MO.—Press reports state that $12,000 has been appropriated for constructing works.

ST. LOUIS, MO.—The council has appropriated $450,000 for extensions and improvements.

FAYETTEVILLE, ARK.—The chamber of commerce is agitating the question of works.

TEXARKANA, TEX.—The council has passed an ordinance annulling the franchise of the Texarkana Water Co., owing to a dispute for several years as to water charges, according to reports.

WEATHERFORD, TEX.—The council has voted to discontinue the service of the water company after July 1 and to join other parties in sinking an artesian well.

WESTCLIFFE, COLO.—It is reported that a system will soon be in operation.

EAST LAS VEGAS, N. M.—The Las Vegas Water Co. has been incorporated; Dr. Jos. M. Cunningham, John W. Zollars, David C. Winters, Miguel A. Otero, Las Vegas, and L. A. Hughes, Santa Fe; capital stock, $500,000.

VISALIA, CAL.—A franchise has been granted the Visalia Water Co. to put in works.

YUMA, ARIZ.—F. B. Wightman, Cy. Clk., writes us that April 10 the city council granted Geo. A. Allen a franchise for works and an electric light plant; supply from Colorado River; population, 1,500. The work is expected to be begun this fall.

MONTREAL, QUE.—Bids are asked until June 26 for supplies for the year, including lead pipe, lead, tin, brick, cement, etc. A. Davis, Supt.

QUEBEC, QUE.—It is reported that a filter plant may be erected, at a cost of $20,000.

TORONTO, ONT.—Bids are asked until June 25 for pipe and hydrants for the London asylum and a reservoir at Brockville asylum. Wm. Harty, Comr. Dept. Pub. Wks.

TORONTO, ONT.—E. H. Keating, Cy. Engr., has reported the estimated cost of proposed new conduits as follows: 6-ft. cast iron pipe, from new intake in the lake to the pumping well, $560,000; or from Hanlan's crib, to the pumping well, $240,000; 6-ft. steel pipe, $518,000, or $237,000; tunnel scheme, as previously recommended, with an extension of pipe to the new intake well, $525,000.

ARTESIAN WELLS.

WASHINGTON, D. C.—A press report states that an amendment has been made to the Indian appropriation bill allowing the expenditure of $5,000 on the artesian wells at the Rosebud, Pine Ridge and Standing Rock agencies, in addition to the $15,000 already appropriated for that purpose. Nothing has been done with the latter sum, for the contractors would not guarantee a flow of water in the three wells for $5,000 each. For $20,000, however, flowing wells are guaranteed.

IRRIGATION.

JUNCTION CITY, KAN.—Geo. Anderson has contracted with Fairbanks, Morse & Co., for an irrigation plant for irrigating 20 acres, and it is stated that if this is successful several thousand acres in this vicinity will soon be irrigated.

MADRID, NEB.—Mass meetings are being held at this place, Grant and other towns to secure an irrigation ditch from the Platte River near Julesburg, Colo., to the eastern line of Perkins county, Neb.

OXFORD, NEB.—Surveys have been made for a ditch at this place, which it is said will soon be constructed.

CRESTED BUTTE, COLO.—Press reports state that contracts are about to be let by English capitalists for a ditch 22 miles long from the Taylor River.

ELLENSBURG, WASH.—The Middle Kittitas irrigation district has sold $200,000 of bonds to Clough & Graves, Spokane. This canal will add 23,180 acres to the producing lands of the valley, according to reports.

NEW COMPANIES.—Roswell Land & Water Co., Roswell, Colo.; $500,000; Percy Hagerman, A. G. Goetz, T. H. Edsall.——Almond Land & Water Co., Los Angeles, Cal.; $14,250; Nicholas Cockran, W. L. Metcalf, W. E. Patterson.

SEWERS.

MEDFORD, MASS.—Bids are asked until June 23 for the purchase of $64,000 of sewer bonds. P. R. Litchfield, Cy. Treas.

WATERTOWN, MASS.—Plans are to be presented at the next town meeting for extending the sewers through the eastern portion of the town. In order to secure an outlet, the system must either be connected with the Cambridge sewers or a tunnel must be constructed under the Charles River. Estimated cost, about $125,000.

EAST HARTFORD, CONN.—W. H. Olmsted, Engr., writes us that plans have been made for a combined system for the meadow district, to discharge into the Connecticut River; 8,000 ft. of 15 to 6-in. pipe sewers; average cut, 7 ft.; estimated cost, $4,500. W. W. Kellar, Chn. Com.

STAMFORD, CONN.—Bids are asked until July 1 for the purchase of $50,000 of sewer bonds, issued to pay for a new outlet sewer. Henry V. Riker, Cy. Treas.

ROCHESTER, N. Y.—Plans have been prepared for constructing a 58 to 48-in. brick sewer, estimated to cost $19,000, and 18-in. pipe sewers in two streets, estimated to cost $4,800.

BLOOMFIELD, N. J.—The council is discussing the construction of a sewer in Broad St., estimated to cost $10,500.

BOUND BROOK, N. J.—H. M. Herbert, Borough Engr., writes us that plans have been prepared for a gravity system; 5.8 miles of 20 to 8-in. pipe sewers; average cut, 8 ft.; estimated cost, $32,432; outlet into the Raritan River. During freshets pumping will be required. The property owners have until June 23 to file objections, and in case 50% object the sewers will not be constructed.

FLEMINGTON, N. J.—It is reported that the citizens have voted to construct sewers.

MONTCLAIR, N. J.—The engineer has been directed to make specifications for constructing lateral sewers in several streets.

PLAINFIELD, N. J.—An ordinance has been introduced into the council for establishing a system, which will become a law July 25, and contracts will then be awarded at once. Address all communications to William MacMurray, Cy. Clk.

ALLEGHENY, PA.—Bids are asked until July 2 for the purchase of $145,000 of sewer improvement bonds. Jas. Brown, Cy. Compt.——The director of public works has been instructed to advertise for bids for constructing sewers in three streets.

CHARLEROI, PA.—Bids are asked until June 28 for constructing four main sewers. C. P. Speers.

NORRISTOWN, PA.—Bids are asked until June 28 for constructing 171 ft. of 3-ft. double-ring brick sewer. Wm. Vaughan, Chn. Com.

PHILADELPHIA, PA.—The department of public works will soon advertise for bids for constructing sewers in four streets, estimated to cost $225,000, and for about 100 branch sewers, to cost about $100,000.

SHARON, PA.—A committee has been appointed to arrange for a system.

SHARPSBURG, PA.—Bids are asked until June 26 for constructing a 10-in. pipe sewer. E. C. Hulbert, Borough Engr.

WILLIAMSPORT, PA.—An ordinance has been introduced in the council to issue bonds for $60,000 for sewers.

WASHINGTON, D. C.—A committee from the medical society of the district has petitioned the House district committee to grant the city authority to issue $7,500,000 in bonds for improving the sewerage system.

LYNCHBURG, VA.—The council has adopted recommendations of the committee for sewers in five streets.

MORGANSTOWN, W. VA.—The citizens will vote on June 23 on issuing $11,000 in bonds for a system.

ALLIANCE, O.—Bids are asked until June 28 for constructing 1,740 ft. of 10 to 6-in. pipe sewers. Thos. Casselman, Cy. Clk.——The following bids have been received for constructing three sewers:

	No. 10.	No. 11.	No. 12.
Henry Anson, Akron	$890	$1,302	$1,360
F. Vesseriat, Alliance	725	1,844	1,980
Campbell Bros., Cleveland	1,079	2,242	1,848
McDowell & McCracken, Cleveland	841	1,938	2,245
Hersey Bros., Youngstown	1,045	2,092	1,859
J. Hadley, Canton	952	2,684	2,755
Berger & McCauley, Alliance	640	2,060	1,756
Urich & Williams, Springfield	995	2,134	1,922
Robert Auld, Alliance	971	....	1,680
Robert Adams, Alliance	637	....	....

JACKSONVILLE, FLA.—The board of public works has recommended that the council vote to engage an engineer to investigate the question of a system.

NEWPORT, KY.—An ordinance has been adopted to issue $40,800 in bonds for sewer construction.

LOUISVILLE, KY.—Bids are asked by the board of public works until June 29 for constructing sewers in three streets.

ATHENS, O.—Bids are asked until July 18 for constructing a system. W. B. Golden, Village Clk.

DAYTON, O.—Bids are asked until July 18 for constructing 17,070 ft. of 15 to 8-in. pipe sewers. F. M. Turner, Cy. Engr.

CHILLICOTHE, O.—The city engineer has completed plans for sewers estimated to cost $22,000.

CINCINNATI, O.—Bids are asked by the board of administration until June 27 for constructing sewers in Winslow Ave.

HAMILTON, O.—A committee has been appointed to investigate the location of a sewage pumping station.

MASSILLON, O.—Bids are asked until June 30 for constructing sewers in two streets. E. B. Bayliss, Cy. Clk.

MOUNT PLEASANT, O.—The council has adopted plans for a system. Dr. J. W. Hunter, Secy.

SANDUSKY, O.—Bids are asked until June 30 for constructing a sewer in Shelby St. A. W. Miller, Cy. Clk.

WOOSTER, O.—Bids are asked until July 6 for constructing 13,067 ft. of 20 to 6-in. pipe sewers. B. F. Eason, Cy. Clk.

HUNTINGTON, IND.—The council has sold $65,000 of sewer bonds at 2½% premium.

DOWAGIAC, MICH.—Hl. Arthur, Cy. Clk., writes us that the contract for making surveys and plans for the proposed system has been let to W. S. Shields, Consult. Engr., Chicago, The entire system will not be constructed this year.

QUINCY, ILL.—Bids are asked by the board of public works until June 27 for constructing sewers.

DELAVAN, WIS.—It is reported that this place is soon to put in a system.

MILWAUKEE, WIS.—It is stated that a contract for constructing 1,700 ft. of the 10-ft. 30th St. tunnel sewer in Wauwatosa will soon be let by the commissioners of public works.

NEENAH, WIS.—Plans for a system have been completed by George W. Sturtevant, Jr., Consult. Engr., Chamber of Commerce Bldg., Chicago. Contracts for part of the work will be let this season.

DES MOINES, IA.—Bids are asked by the board of public works until June 23 for constructing a 48-in. double ring brick sewer 11,000 ft. in length.

HELENA, MONT.—The following bids have been received for constructing 13,461 ft. of 8 to 4-in. pipe sewers at Fort Harrison:

Kansas City Bldg. & Construction Co.	$12,101
Riddell, Sulter & Pease	13,899
H. B. Palmer	13,864
Adams & Rider	11,449
F. F. Fleming	13,464
D. P. Wortman	10,689
H. McDonald	13,790
Wm. T. Semper	11,943
J. P. Courtney	12,736
George MacCleary	14,101
Twohy & Wells	12,907
Fred Yungren, Minneapolis	10,651
F. J. Shaffer	15,822
Walker & Aitchison	15,845
Gould Bros	11,604
McKay Bros	11,799
Kunts & McCann	12,324
Johnson & Linquist	15,996
H. Kirkendall	11,874
Sturrock & Preuitt	14,900

KANSAS CITY, MO.—Bids are asked until June 29 for constructing a sewer. John Donnelly, Cy. Engr. ——The board of public works has approved plans for extending the Goose Neck sewer at an estimated cost of about $80,000.

SANTA FE, N. MEX.—The committee on public works is considering the application of R. E. Twichell, Santa Fe, and M. A. Otero, Las Vegas, for a franchise to construct a system, with the right of the city to purchase after 15 years.

FRESNO, CAL.—The board of public works is discussing the construction of a sewer to cost $34,000, for which the surveys have been made.

POMONA, CAL.—A committee, consisting of Phil Stein, F. J. Smith and J. E. Packard, has been appointed to investigate the question of a system.

SAN FRANCISCO, CAL.—The Mission Overflow District Association has petitioned for the construction of 3,300 ft. of main brick sewers; estimated cost, $31,000.

MONTREAL, QUE.—Bids are asked until June 27 for constructing sewers in five streets. P. W. St. George, Cy. Surv.

NIAGARA FALLS, ONT.—The citizens will vote on appropriating $88,000 for a system.

TORONTO, ONT.—Bids are asked until June 25 for sewage disposal works at Kingston asylum and extension of main sewer at Orillia asylum. Wm. Harty, Comr. Dept. Pub. Wks.

STREETS.

MERIDEN, CONN.—Bids are asked until July 9 for paving a portion of Main St. with granite blocks, as stated in our advertising columns. W. S. Clarke, Cy. Engr.

BROOKLYN, N. Y.—Bids are asked until June 25 for flagging sidewalks in 14 streets and for paving one street with cobblestones; and until June 27 for grading and paving one street with cobblestones and repaving one with asphalt. A. T. White, Comr. Cy. Wks.

BUFFALO, N. Y.—The board of aldermen has received the following bids for paving North Ogden St.: German Rock Asphalt & Cement Co., $69,000; Barber Asphalt Paving Co., $69,439; P. B. McNaughton, brick, $51,320; W. E. Hingston, brick, $52,000.

MOUNT VERNON, N. Y.—Bids are asked for paving Fifth Ave., from First to Sixth Sts., with asphalt; estimated cost, $40,000.

NEW UTRECHT, N. Y.—Bids are asked until June 26 for paving and grading 18 streets; appropriation, $500,000. Engr., Sam'l H. McElroy; Cornelius Furguson, Jr., Supervisor, 26 Court St., Brooklyn.

NEW YORK, N. Y.—The board of street opening has prepared plans for a boulevard 182 ft. wide from 163d St. to Van Cortlandt Park, a distance of four miles. All cross streets are to be crossed by viaducts to avoid grade crossings. It is thought that five or six years will be required to complete the work, which is estimated to cost $9,000,000.

NIAGARA FALLS, N. Y.—Bids are asked until June 22 for 6,600 sq. yds. of brick or block paving. A. H. Porter, Cy. Engr.

ROCHESTER, N. Y.—The following paving has been authorized: Four streets with cement, estimated to cost $16,500, macadamizing one street, to cost $23,000, and paving North Goodman St. with asphalt, estimated to cost $12,400.

SALAMANCA, N. Y.—J. B. Swan, Village Clk., writes us that it is proposed to pave 10,000 sq. yds. with brick, but no contracts have been awarded or specifications yet prepared.

TROY, N. Y.—The contracting board has received the following bids for paving Second St. with granite blocks: P. McKenna, $69,270; Casey & Cavanaugh, $69,842; Besch & Farrell, $68,885; J. H. Cavanaugh, $70,945; Edmund Broderick, $72,475; Martin Murray, $66,205, awarded contract.

ELIZABETH, N. J.—Bids are asked until July 10 for 1,250 sq. yds. of telford macadam paving and 350 sq. yds. of trap block paving. N. K. Thompson, St. Comr.

NEWARK, N. J.—It is proposed to pave Plane St. with granite blocks.

ALLEGHENY, PA.—Bids are asked until July 2 for the purchase of $200,000 of street improvement bonds. James Brown, Cy. Comptroller.

BRADFORD, PA.—It is stated that an election is to be held to vote on issuing bonds for street paving.

MOUNT CARMEL, PA.—Bids are asked until June 27 for grading Vine St. W. F. King, Chn.

NORRISTOWN, PA.—Bids are asked until June 28 for about 1,000 cu. yds. of grading for macadam. William Vaughan, Chn. Com.

WILLIAMSPORT, PA.—An ordinance has been introduced in council to issue $25,000 of bonds for paving.

GLEN ELK, W. VA.—It is proposed to spend $15,000 for brick paving in Elk City. C. Summers, Village Recdr.

BOWLING GREEN, KY.—It is stated that the mayor will ask for bids for improving and opening several streets.

COVINGTON, KY.—T. H. Kennedy, Cy. Engr., writes us that a contract for 10,000 sq. yds. of paving will be awarded about July 1.

LOUISVILLE, KY.—Bids are asked by the board of public works until June 29 for paving sidewalks in eight streets.

AKRON, O.—Bids are asked until July 14 for grading and paving Adolph St. F. C. Wilson, Cy. Clk.

ASHLAND, O.—The engineer has estimated the cost of paving Center St. with brick at $9,585. It is also intended to pave Claremont St. with brick.

AVONDALE, O.—Bids are asked until July 14 for improving three streets. W. E. Wynne, Corporation Clk.

BUCYRUS, O.—Bids are asked until July 17 for improving Spring St. H. L. Weber, Cy. Engr.

CINCINNATI, O.—The contracts for paving three sections of Madisonville Ave. have been awarded to J. Delaney at $21,222, $2,761 and $9,358. The contract for improving Northside Ave. has been awarded to J. McDermott at $9,500.

CLEVELAND, O.—Bids are asked until July 18 for paving one street with brick and one with dressed block Medina sandstone. J. H. Farley, Dir. Pub. Wks.

COLLEGE HILL, O.—Bids are asked until June 27 for constructing a cement sidewalk. F. R. Strong, Village Clk.

DAYTON, O.—Bids are asked until June 25 for paving sidewalks with either cement, stone or asphalt in 26 streets; until June 28 for sidewalks in 30 streets; until July 2 for 67,180 sq. yds. of paving with asphalt, asphalt blocks, brick or granite, and until July 16 for 50,435 sq. yds. of paving. F. M. Turner, Cy. Engr.

MARION, O.—It is probable that bids will be asked about July 1 for street paving.

MILFORD, O.—The council has passed an ordinance to issue $10,000 in bonds for street improvements.

NORWOOD, O.—Bonds for $16,504 have been sold for improving Carthage Ave.

WOOSTER, O.—Bids are asked until July 6 for macadamizing, grading and paving Spruce St. with brick. B. F. Eason, Cy. Clk.

IONIA, MICH.—Bids are asked until June 27 for 1,500 ft. of paving on Main St. Fred. Cutler, Jr., Cy. Clk.

BELLEVILLE, ILL.—The contract for paving Main St. with one course of brick on 6 ins. of concrete, with 6-in. curbing, has been awarded to Abbot-Gamble Contracting Co., St. Louis, Mo., at $11.75 per lin. ft.

MILWAUKEE, WIS.—Bonds for $207,000 have been sold at an average price of about $110. It is stated that more street improvement bonds will be sold soon, making a total of $600,000 issued this year.

EXETER, NEB.—The committee has been directed to improve Main St.

ST. LOUIS, MO.—Bids are asked by the board of public improvements until June 27 for improving sidewalks with asphalt, brick, macadam or stone.

GALVESTON, TEX.—The secretary of the board of public works has been directed to advertise for bids for street paving.

MONTREAL, QUE.—Bids are asked until June 27 for constructing asphalt and composition sidewalks during the rest of the year. P. W. St. George, Cy. Surv.

TORONTO, ONT.—It is proposed to pave Bloor St. with cedar blocks on concrete; estimated cost, $15,400.

ELECTRIC LIGHT AND POWER.

ELLSWORTH, ME.—The committee estimates the cost of a plant of 30 arc lights and eight miles of wire at $5,000, or that a plant of 18 lights could be bought for $3,500, and the cost of running the plant for one year at $1,300.

BROCKTON, MASS.—The council has voted to direct the committee to advertise for bids for street lighting.

ALLEGHENY, PA.—The committee on public works has received the following bids for an additional building on Braddock Ave. for the electric light plant: Jas. Wherry, $29,852; W. F. Trimble & Sons, $29,600; Samuel Hastings, $28,000; B. A Broah, $27,000; R. C. Tannehill, $25,893.

WASHINGTON, D. C.—Bids were opened by the Supervising Architect of the Treasury, June 15, for the electric light plant at the U. S. Marine Hospital at Portland, Me., as follows:

John M. Fox, Portland, Me.	$4,300 and $4,600	60	days.
Portland Electrical Wks, Portland, Me.	3,905	60	"
General Electric Co., Boston.	$5,554 and 6,400	60	"
C. & C. Electric Co., New York	5,700	60	"
Cumner, Craig & Co., Boston	6,049	90	"
Blodgett Bros. & Co., Boston	4,895	90	"
Davidson Ventilating Fan Co., Boston.	$6,445 and 5,594	90	"
Elektron Mfg. Co., Boston	5,978	70	"
Morrison Southern Electric Co., Baltimore	$7,621 and 6,958	70	"
International Trading & Electric Co., New York	6,538	70	"
Belknap Motor Co., Portland, Me. (nine bids)	$3,248 to 4,408	70	"

ALEXANDRIA, LA.—Bids will soon be asked for electric lighting, according to reports.

MONTPELIER, O.—A company has petitioned for a 10-year franchise to establish an electric light plant of about 60 arc and 60 incandescent lamps, according to reports.

LOGANSPORT, IND.—The city clerk has been directed to advertise for bids for erecting an electric light station.

OAK PARK, ILL.—The clerk of the town board of Harlem has been directed to advertise for bids for an electric plant in connection with the water-works.

AUSTIN, TEX.—The board of public works has recommended that bids be asked for the power-house foundation.

PORTLAND, ORE.—Bids are asked by the committee until Sept. 1, for lighting the streets with 605 arc and 710 incandescent lamps for two years.

LOS ANGELES, CAL.—A franchise has been asked for by Maj. A. W. Barrett to put in an electric light plant.

NEW COMPANIES.—Solar Arc Lamp Co., New York, N. Y.; $25,00; J. Rice, P. Boice, H. Boice.——Bement Electric Light & Power Co., Bement, Ill.; capital stock increased from $5,000 to $10,000.——Diamond Electric Co., Peoria, Ill.; $60,000; J. M. Francis, W. E. Francis, G. A. Schafer.——Berkeley Electric Lighting Co., Berkeley, Ill.; $100,000; W. E. Sell, J. G. Gardner, C. K. Clark, J. R. Little, A. S. Blake.——Citizens' Light & Power Co., Norway, Mich.; $10,000.——Little Plover Water Power & Trout Co., Stevens Point, Wis.; $10,000; J. O. Raymond, E. B. Park, D. N Bean.——Citizens' Electric Light & Power Co., Pensacola, Fla; $20,000; Pres., T. E. Welles; Secy. and Treas., C. J. Heinburg, Gen. Man., W. B. Crossland.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

FIRE ENGINE.—Jamestown, R. I.—The citizens have voted to appropriate $3,500 for a steam fire engine.

DAM.—Hot Springs, S. Dak.—E. T. Evans is reported as about to contract for the construction of a dam.

BRUSH, ETC.—Memphis, Tenn.—Bids are asked at the U. S. Engineer's Office until June 30 for furnishing brush, poles, rope, etc., as stated in our advertising columns. Capt. S. W. Roessler, U. S. A.

STAIRWAYS AND ELEVATOR GUARDS.—Canton, O.—Bids are asked in our advertising columns for the construction of stairways and elevator guards in the Stark county court house. L. A. Loichol, Clk. Bd.

LIFE-SAVING STATIONS.—Washington, D. C.—Bids are asked until June 23 for the construction of two life-saving stations on Seven Mile Beach, N. J., as stated in our advertising columns. S. I. Kimball, Supt. U. S. Life-Saving Service, Treasury Dept.

LIGHT FIXTURES.—Washington, D. C.—Bids are asked until July 9 for manufacturing and placing in position in complete working order in the U. S. buildings, at Duluth, Minn.; Galesboro, Ill.; Jackson, Mich.; and Paris, Tex., combination gas and electric light fixtures. S. Wike, Acting Secy., Treasury Dept.

GARBAGE DISPOSAL.—Rochester, N. Y.—The contract for collecting and disposing of the city garbage for ten years has been awarded to J. A. Lighthall, Jr., Syracuse, at $28,971 per year, and that for night soil for five years to Mr. Lighthall at $5,000 per year. The city is at present paying $34,000 per year for this besides renting land for the burning of the matter.

BONDS.—Philadelphia, Pa.—Bids are asked until June 25 for the purchase of $3,000,000 of 4% city bonds. Edwin S. Stuart, Mayor.

Chicago, Ill.—Bids are asked until July 11 for the purchase of $3,000,000 of 4% bonds. Thos. F. Judge, Clk. Sanitary District of Chicago.

FIRE ENGINES.—Houston, Tex.—Bids are asked until July 9 for one third class fire engine, one chemical fire engine and two hose wagons. John T. Browne, Mayor.

PARK IMPROVEMENTS.—Milwaukee, Wis.—Bids are asked until June 26 for grading a lake in West Park. Chas. K. Lush, Secy. Comrs.

Cleveland, O.—A contract for improvements in the new West Side park has been awarded to F. H. Eggers at $20,112; engineer's estimate, $40,000.

HEATING AND VENTILATING APPARATUS.—Washington, D. C.—Bids are asked until July 6 for the steam heating and ventilating apparatus for the U. S. building at Houlton, Me., as stated in our advertising columns. Jeremiah O'Rourke, Supervising Arch.

PUBLIC WORK.—Toronto, Ont.—Bids are asked until June 25 for the following work: Hydrants and cast iron pipes, London asylum; infirmary, Hamilton asylum; sewage disposal works, Kingston asylum; reservoir, barn and stables, slaughter house, piggery, driving house, steam and hot water heating, Brockville asylum; extension of main sewer, addition to boiler house and

steam boiler, Orillia asylum; barn and hot water boiler, Brantford institute. Wm. Harty, Comr. Dept. Pub. Wks.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
June 22.	Bridge abutments,	Hamilton, O.	June 7
June 22.	Elevator, pub. bldg.,	at Lincoln, Neb.	June 7
	Advertised, Eng. News, June 7 to 14.		
June 22.	Street imp'v'ts (24),	St. Louis, Mo.	June 7
June 22.	Paving (6,600sq.yds.)	Niagara Falls,N.Y.	June 21
June 22.	Brick sewer,	Brooklyn, N. Y.	June 14
June 23.	Sewers,	Portsmouth, Va.	May 31
	Advertised, Eng. News, May 31, June 7.		
June 23.	Sewers,	Akron, O.	June 7
June 23.	Water bonds,	Rockville, Conn.	June 14
June 23.	Curbstone,	Apollo, Pa.	June 14
June 23.	Elevator,	Birmingham, Ala.	June 14
	Advertised, Eng. News, June 14 and 21.		
June 23.	Grading,	Little Rock, Ark.	June 14
June 23.	Sewer bonds ($64,000),	Medford, Mass.	June 21
June 23.	Life-saving station,	Washington, D. C.	June 21
	Advertised, Eng. News, June 21.		
June 23.	Bridge,	Dundee, Mich.	June 21
June 23.	Water-works,	Coon Rapids, Ia.	June 23
June 23.	Brick sewer (11,000 ft.),	Des Moines, Ia.	June 21
June 25.	Water-works bonds,	Cadiz, O.	May 31
June 25.	Water-works system,	Farmington, Ill.	May 17
	Advertised, Eng. News, May 17 to 31.		
June 25.	Electric franchise,	Paducah, Ky.	June 7
June 25.	Bonds,	Madisonville, O.	June 7
June 25.	Bridge bonds,	Hastings, Minn.	June 7
June 25.	Sewers,	Union, N. J.	June 14
June 25.	Asylum building,	Milledgeville, Ga.	June 14
June 25.	Brick sewer,	Covington, Ky.	June 14
June 25.	Plans for hotel,	Richmond, Ind.	June 14
June 25.	Water bonds,	Lincoln, Mass.	June 21
June 25.	Flagging (14 sidewalks),	Brooklyn, N. Y.	June 21
June 25.	Bonds ($3,000,000),	Philadelphia, Pa.	June 21
June 25.	Paving sidewalks (26),	Dayton, O.	June 21
June 25.	Laying service pipes,	Dayton, O.	June 21
June 25.	Sewage disposal works,	Toronto, Ont.	June 21
June 26.	Armory,	Cleveland, O.	June 7
June 26.	Sewers,	New York, N. Y.	June 14
June 26.	Granite paving,	New York, N. Y.	June 14
June 26.	Pumping engines,	Springfield, O.	June 14
	Advertised, Eng. News, June 14 and 21.		
June 26.	Brick paving,	Houston, Tex.	June 14
June 26.	Paving (18 streets),	New Utrecht, N. Y.	June 21
June 26.	Park improvements,	Milwaukee, Wis.	June 21
June 26.	Leadpipe, etc.,	Montreal, Que.	June 21
June 26.	Pipe sewer,	Sharpsburg, Pa.	June 21
June 27.	Courthouse at	Mankato, Minn.	June 7
June 27.	Brick paving,	Oak Harbor, O.	June 7
June 27.	Paving,	Brooklyn, N. Y.	June 21
June 27.	Grading,	Mt. Carmel, Pa.	June 21
June 27.	Sewers,	Cincinnati, O.	June 21
June 27.	Cement sidewalk,	College Hill, O.	June 21
June 27.	Paving,	Ionia, Mich.	June 21
June 27.	Sewers,	Quincy, Ill.	June 21
June 27.	Sidewalks,	St. Louis, Mo.	June 21
June 27.	Sewers,	Montreal, Que.	June 21
June 27.	Paving sidewalks	Montreal, Que.	June 21
June 28.	Sewer,	Cincinnati, O.	June 7
June 28.	Lowering machinery,	Huntington, Ind.	June 7
June 28.	Sewers,	Charleroi, Pa.	June 21
June 28.	Brick sewer,	Norristown, Pa.	June 24
June 28.	Grading,	Norristown, Pa.	June 21
June 28.	Sewers (1,740 ft.),	Alliance, O.	June 21
June 28.	Paving sidewalks (30),	Dayton, O.	June 21
June 29.	Street improvement bonds,	Norwood, O.	June 7
June 29.	Sewers,	Kansas City, Mo.	June 21
June 29.	Sewers,	Louisville, Ky.	June 21
June 29.	Paving sidewalks,	Louisville, Ky.	June 21
June 29.	Pipe, reservoir, etc.,	Toronto, Ont.	June 21
June 30.	Bridge,	Marion, Ind.	June 7
June 30.	Ditch,	Washington, Ind.	June 7
June 30.	Highways,	Cincinnati, O.	June 14
June 30.	Bonds,	Faribault, Minn.	June 14
June 30.	Railway excavation,	Evansville, Ind.	June 21
	Advertised, Eng. News, May 24 to June 14.		
June 30.	Lining tunnel,	Evansville, Ind.	June 21
	Advertised, Eng. News, May 24 to June 14.		
June 30.	Brush, etc.,	Memphis, Tenn.	June 21
	Advertised, Eng. News, June 21, 28.		
June 30.	Sewers,	Massillon, O.	June 21
June 30.	Sewers,	Sandusky, O.	June 21
July 1.	Sewer bonds,	Wallace, Idaho.	May 31
July 1.	Water-works,	Lancaster, N. Y.	June 7
	Advertised, Eng. News, June 7 and 14.		
July 1.	Bridge,	Warren, O.	June 14
	Advertised Eng. News, June 14 and 21.		
July 1.	Sewer bonds ($50,000),	Stamford, Conn.	June 21
July 1.	Bridge,	Murphy, N. S.	June 21
July 2.	Water-works system,	Centreville, S.Dak.	May 31
July 2.	Paving,	Dayton, O.	June 7
July 2.	Bridge,	Hastings, Minn.	June 7
	Advertised, Eng. News, June 7.		
July 2.	Bridge,	Tower City, Pa.	June 14
July 2.	Water bonds,	Ipswich, Mass.	June 21
July 2.	Sewers,	Athens, O.	June 21
July 2.	Water bonds,	Bellevue, O.	June 21
July 2.	Paving (67,180 sq. yds.),	Dayton, O.	June 21
July 2.	Sewer & St. imp'v't bonds,	Allegheny, Pa.	June 21
July 3.	Pipe,	Victoria, B. C.	May 24
July 3.	Metal work at	Key West, Fla.	June 7
	Advertised, Eng. News, June 7 to 28.		
July 3.	Electric lighting,	Hopkinsville, Ky.	June 7
July 3.	Sewer bonds,	Hamilton, O.	June 7
July 3.	Heat'g, vent'l'g apparatus,	Lowell, Mass.	June 14
	Advertised, Eng. News, June 14 and 21.		
July 3.	Paving,	Dunkirk, N. Y.	June 14
	Advertised, Eng. News, June 14 and 21.		
July 3.	Paving,	York, Pa.	June 14
	Advertised, Eng. News, June 14 to 28.		
July 3.	Sewers,	Hamilton, O.	June 14
July 3.	Brick paving,	Lima, O.	June 14
July 3.	Bridge,	Jersey Shore, Pa.	June 21
July 5.	Water-works system,	Waukegan, Ill.	June 21
	Advertised, Eng. News, June 21, 28.		
July 5.	Water-works and bonds,	Wilber, Neb.	June 14
July 6.	Water-works,	Jefferson, Ia.	June 14
	Advertised, Eng. News, June 14 to 28.		
July 6.	Heat'g, vent'l'g apparatus,	Ft. Dodge,Ia.	June 14
	Advertised, Eng. News, June 14 and 21.		
July 6.	Heat'g, vent'l'g apparatus,	Houlton, Me.	June 21
	Advertised, Eng. News, June 21, 28.		
July 6	Sewers (13,067 ft.),	Wooster, O.	June 21
July 6.	Paving,	Wooster, O.	June 21
July 6.	Bridge, Red Wing,	Minn.	June 21
	Advertised, Eng. News, June 21, 28.		
July 6.	Water-works,	Earlville, N. Y.	June 21
July 7.	Water-works, St. Bernard,	O.	June 7
	Advertised, Eng. News, June 7 to 21.		
July 7.	Electric light plant, St. Bernard,	O.	June 7
	Advertised, Eng. News, June 7 to 21.		
July 7.	Street improvements,	Mansfield, O.	June 14
July 9.	Bridge,	Dallas, Tex.	June 7
July 9.	Plans for city hall,	Peoria, Ill.	June 14
July 9.	Electric wiring,	Dallas, Tex.	June 14
July 9.	Paving,	Meriden, Conn.	June 21
	Advertised, Eng. News, June 21.		
July 9.	Light fixtures,	Washington, D. C.	June 21
July 9.	Pipe, etc.,	Downer's Grove, Ill.	June 21
	Advertised, Eng. News, June 21 to July 5.		
July 9.	Water-works system,	Bellevue, Ia.	June 21
	Advertised, Eng. News, June 21.		
July 9.	Fire engines,	Houston, Tex.	June 21
July 10.	Bridge,	Cathlamet, Wash.	May 31
July 10.	Masonry arch work	New York, N. Y.	June 14
July 10.	Macadam,	Elizabeth, N. J.	June 21
July 11.	Bonds ($3,000,000),	Chicago, Ill.	June 21
July 12.	Bridge subst'r & appr'chs,	Cleveland, O.	June 21
July 14.	Paving,	Akron, O.	June 21
July 14.	Street improving,	Avondale, O.	June 21
July 14.	Stand-pipe,	Zanesville, O.	June 21
July 16.	Paving (50,435 sq. yds.),	Dayton, O.	June 21
July 17.	Stone work,	Newport, R. I.	June 7
	Advertised, Eng. News, June 7 to 28.		
July 17.	Street improvements,	Bucyrus, O.	June 21
July 18.	Sewers (17,070 ft.),	Dayton, O.	June 21
July 18	Paving,	Cleveland, O.	June 21
July 31.	Bridge,	New Westminster, B. C.	June 21
Aug. 6.	Electric lighting,	Rome, N. Y.	June 14
Sept. 1.	Electric lighting,	Portland, Ore.	June 21
No date.	Stairway, etc.,	Canton, O.	June 21
	Advertised, Eng. News, June 21, 28.		
"	" Railway,	Binghamton, N. Y.	June 14
"	" Paving,	Mount Vernon, N. Y.	June 21
"	" Water-works,	Alexandria, La.	June 21

CONTRACT PRICES.

PIPE.—Danville, Ky.—E. W. Smith, Res. Engr., writes us that the lowest bid received for furnishing pipe for the new works was that of Dennis Long & Co., Louisville, at $16.94 per ton.

Hebron, Neb.—A contract for 1,600 ft. of 8-in. 40-lb. water pipe has been awarded to Shickle, Harrison & Howard Iron Co., St. Louis, at $22.70 per ton f. o. b. cars in this city. The South Pittsburg Pipe Co. bid $15.50, at South Pittsburg, Tenn. Engr., F. L. Burrell, Fremont, Neb.

Canton, Ill.—The following bids have been received for a supply of cast iron pipe, the price in the second column being that per cent per pound for special castings:

Anniston Pipe & F'ndry Co., Anniston, Ala.	$18.10	2¼
Southern Pipe Foundries, Chicago	17.60	2¼
Cast Iron Wtr. & G. P. Co., S. Pitts'g, Tenn.	17.75	2
J. B. Clow & Son, Chicago	18.10	2¼
Geo. C. Morgan, Chicago	18.25	2¼
Addyston Pipe & Steel Co., Cincinnati	17.75	2 1-10
Ripley-Detrick Supply Co., Chicago	18.75	2½
J. B. McAuley	19.00	2½
Dennis Long & Co., Louisville, Ky.	18.40	2¼

ASPHALT PAVING.—Schenectady, N. Y.—Lewis B. Sebring, Cy. Engr., writes us that the contract for paving 2,000 sq. yds. in South Centre St. with asphalt has been awarded to the Northern New York Asphalt Paving Co., Troy, at $3.19 per sq. yd. The Barber Asphalt Paving Co., New York, bid $3.42.

Troy, N. Y.—The contract for paving Maple Ave. with asphalt has been awarded to the Northern New York Asphalt Paving Co., at $3.28 per sq. yd. Besch & Farrell bid $3.40.

BRICK PAVING.—Jacksonville, Fla.—The following bids were received June 11 for paving in Main St. with brick: Bisbee & Foster, $1.23 per sq. yd. for work complete with Robbin's small paver, $1.56 Chillbarney blocks, or $1.37 with Hallwood blocks; Chas. Spinks & Son, Newport, Ky., $2 with Kentucky blocks; would furnish the blocks alone for 81 cts. at the works or $1.75 in Jacksonville; would do the work alone at 25 cts.; Jos. Marzyck and J. T. Parry, 35 cts. for the work; A. W. Smith, Jacksonville, 25 cts. for the work; Coaldale Brick & Tile Co., furnish brick at works for 50 to 58 cts., or at Jacksonville for 82 to 90 cts. A test was ordered made of the Coaldale "A." Robbin's small and the Hallwood block. The grading is to be done by the city and will cost about 12 cts. per sq. yd.

GRANITE PAVING.—Troy, N. Y.—The contract for paving Second St., between Adams and Main Sts., with granite blocks has been awarded to Martin Murray, at $2.55 per sq. yd.; total bid, $66,205. There were five other bids ranging from $2.68 to $2.70.

Schenectady, N. Y.—The following bids were received for 3,000 sq. yds. of granite paving in Rotterdam St., the price being given per sq. yd. and including curbing, flagging, basins, etc.; L. B. Sebring, Cy. Engr.

Twomey, Shear & Haight, Schenectady	$2.95
C. D. Houlihan, Cohoes	3.16
Devine & Veeder, Schenectady	3.17
C. H. Cavanaugh, Troy	3.30
Pigeon & Co., Albany	3.31
R. H. Strong, Albany	3.38

SEWERS.—Central Falls, R. I.—L. C. Heywood, Engr., Pawtucket, R. I., informs us that the following bids were received June 9 for constructing a sewer in Dexter and Crossman Sts., in the town of Lincoln:

Quantities.	Kenneth McKay.	Fred Shaw.	J. D. Brown.	Latimer Bros.	McCusker.
90 × 60-in. 860 ft.	$2.63	$4.00	$2.75	$3.28	$4.40
48-in., 630 ft.	2.22	3.50	2.25	3.17	3.65
32 × 48-in., 460 ft.	2.28	3.25	1.90	2.95	3.35
30 × 45-in., 490 ft.	2.10	3.00	1.60	2.88	3.25
20 × 30-in., 530 ft.	1.45	2.00	1.40	2.25	2.00
18-in., 480 ft.	1.05	1.00	1.00	.70	1.35
15-in., 300 ft.	1.05	1.00	.80	.60	1.35
8-in., 800 ft.	.35	.50	.75	.50	.25
Open trench, 230 cu. yds.	2.45	4.00	1.00	1.98	2.25
Cement, 650 cu. yds.	2.10	2.00	3.00	2.50	2.15
Bevel conn's, 12 to 18-in.	.25	1.00	.30	.14	.25
" " 8-in., 50	.25	.20	...	.10	.25
" " 6-in., 160	.25	.10	.20	.10	.25
Manholes, 15	17.00	15.00	18.00	13.00	15.00
Catch basins, 43	18.00	15.00	25.00	17.00	18.00
Inlets, 17	10.00	10.00	10.00	2.25	3.00
Spruce lumber, 1 M. ft.	25.00	25.00	17.00	17.00	25.00
" " 40 M. ft.	14.00	10.00	17.00	14.00	20.00
Paving, 2,000 sq. yds.	.20	.15	.20	.25	.25
Total	13,414	15,794	13,610	15,789	17,556

METAL MARKET PRICES.

LEAD.—New York: 3.25 to 3.3 cts. Chicago: 3.12 cts. St. Louis: 3.05 cts.

NAILS.—Pittsburg: $1.10 for wire, and 95 cts. to $1 for cut at mill.

FOUNDRY AND PIG IRON.—New York: $10 to $13. Pittsburg: $10.75 to $11.75. Chicago: $10 to $11.50.

TRACK MATERIAL.—New York: angle bars, 1.2 to 1.4 cts.; spikes, 1.5 to 1.7 cts.; track bolts, 2 to 2.1 cts. with square and 2.1 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.35 to 1.4 cts.; spikes, 1.75 to 1.9 cts.; track bolts, 2.1 to 2.15 cts., with hexagon nuts.

RAILS.—New York: $24 to $25 at eastern mills and at tidewater; old rails, $10 to $11 for iron, and $9 to $10 for steel; light rails, $22 to $24; girder rails, $21 to $24. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $10 for iron and $9.50 to $10 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.4 to 1.5 cts.; channels, 1.4 to 1.5 cts.; angles, 1.3 to 1.35 cts.; tees, 1.5 to 1.6 cts.; universal mill plates, 1.25 to 1.35 cts.; steel plates, 1.3 to 1.35 cts. for tank, 1.4 to 1.45 cts. for shell, 1.6 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.3 to 1.35 cts.; channels, 1.3 to 1.35 cts.; angles, 1.2 to 1.25 cts.; tees, 1.35 to 1.4 cts.; universal mill plates, 1.2 to 1.25 cts.; steel plates, 1.25 to 1.3 cts. for tank, 1.4 to 1.5 cts. for shell, 1.45 to 1.6 cts. for flange, 2 to 4 cts. for firebox. Chicago: beams, 1.5 cts.; channels, 1.5 cts.; angles, 1.45 cts.; tees, 1.65 cts.; universal plates, 1.45 cts.; steel plates, 1.45 to 1.5 cts. for tank, 1.5 to 1.6 cts. for shell, 1.65 to 2.1 cts. for flange, 2.5 to 5 cts. for firebox.

INDUSTRIAL NOTES.

LOCOMOTIVES.—The Marion Phosphate Co., of Savannah, Ga., wants a second-hand tank engine of 3-ft. gage, with cylinders about 7 × 12 ins. A dummy engine is wanted by Law & Trammell, of Brooksville, Fla.

THE CLONBROCK STEAM BOILER WORKS have closed a contract with the Edison Electric Illuminating Co. for 4,000 HP. of Climax boilers for their First District stations on Pearl St., Brooklyn, N. Y.

THE DETROIT FOUNDRY EQUIPMENT CO., Detroit, and Chicago, has been awarded the contract for equipping the new shops of J. H. Bass & Co., Lenoir, Tenn., with the Whiting car wheel system.

MR. L. K. HIRSCH, who is carrying on a large business in the purchase and sale of steel rails, relaying and new, second-hand cars and locomotives and other railway material, has purchased a large tract at Washington Heights, Ill., and has established storage yards at that point. Temporary shops are at once to be erected for rebuilding the World's Fair Movable Sidewalk cars (advertised on another page) into contractors' dump and mining cars of any specified gage. At a later date permanent shops are to be built here for carrying on a general car repairing business. Mr. Hirsch's offices are at 549, The Rookery, Chicago.

NEW COMPANIES.—California Railway Equipment Co., San Francisco, Cal.; $500,000; John W. Bourdette, S. C. Denson and W. R. Craig.——Guarantee Construction Co., Chicago, Ill.; $100,000; M. P. Noyes, W. C. Engler and W. R. Heath.——Duplex Dynamite Cartridge Machine Co., Chicago, Ill.; $50,000; H. P. Hall and A. Bernauer.——Solar Arc Lamp Co., Brooklyn, N. Y.; $25,000; Jacob Rice and Peter Boice, of Rondout, N. Y.——Narragansett Improvement Co., Hoboken, N. J.; $25,000; E. W. Everson, of Providence, R. I.; G. W. S. Whitney, Orange, N. J.——Laurie Engine Co., Montreal, Canada; $250,000; John Laurie, A. A. Ayer and J. A. Ogilvie.——Griffiths & McDermott Construction Co., Chicago, Ill.; $75,000; Michael McDermott, J. G. McKinney and A. B. Macklin.

ADVERTISEMENTS.

NOTICE TO STREET PAVING CONTRACTORS.

Sealed proposals addressed to the Street Committee of the City of Meriden, Conn., indorsed Proposals for Street Paving, will be received at the office of the City Engineer, Room 2, Town Hall building, until Monday, July 9th, 1894, at 12 o'clock noon, for paving with granite block pavement that portion of East Main Street, from the crossing of the New York, New Haven & Hartford R. R. easterly to the easterly side of Veteran Street. Specifications and blank forms of proposals can be obtained at the above office, the Street Committee reserving the right to reject any or all bids in behalf of said city's interests, as they deem best.

W. S. CLARK,
25 1t City Engineer.

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., June 14, 1894.—Sealed Proposals will be received at this office until 2 o'clock p. m. on the 6th day of July, 1894, and opened immediately thereafter, for all the labor and materials required for steam heating and ventilating apparatus for the U. S. Custom House and Post Office building at Houlton, Me., in accordance with drawings and specification, copies of which may be had at this office, or at the office of the Superintendent at Houlton, Me. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. Proposals received after the time stated will be returned to the bidders. The Government reserves the right to reject any or all bids or to waive any defect or informality in any bid should it be deemed in the interest of the Government to do so. Proposals must be inclosed in envelopes, sealed and marked, "Proposal for Steam Heating and Ventilating Apparatus for the U. S. Custom House and Post Office Building at Houlton, Me., and addressed to JEREMIAH O'ROURKE, Supervising Architect. 25-2t

NOTICE TO CONTRACTORS.—PAVEMENTS.—CITY OF DUNKIRK, N. Y.

DECLARATION OF INTENTION.

Notice is hereby given that the following resolution was duly passed at a regular meeting of the Common Council of the City of Dunkirk held May 1st, 1894:

Resolved, By the Common Council of the City of Dunkirk, that it is its intention to forthwith improve Central Avenue, from the end of the now macadam pavement in said city to the southern boundary of said city, by grading and paving or macadamizing the same.

And notice is hereby given that the said Common Council will receive bids for the work and materials for improving said street upon specifications to be delivered to any person desiring to make such bid on the job of doing the work and furnishing the materials therefor, which said bids will be opened and examined by the Common Council of the City of Dunkirk, at the Council Chambers in said city, on the 3d day of July, 1894, at 8 o'clock P. M. All bids must be made upon the bidding sheets furnished by the city, and must be accompanied with a certified check, payable to the order of the City Treasurer of the City of Dunkirk, for five per centum of the costs of such improvement at the price fixed by such bidder. The said Common Council hereby reserves the right to reject any and all bids that may be made.

The approximate amount of work to be done is as follows:

3,706 cu. yds. excavation.
8,800 sq. yds. pavement.
3,900 lin. ft. curbing, furnished and set.
3,960 lin. ft. 4-in. drain tile.

All communications respecting the foregoing resolution and notices should be addressed to

J. M. HACKETT,
City Engineer, Dunkirk, N. Y.

Dated Dunkirk, N. Y., June 13, 1894.

JNO. F. MALONEY,
24-2t City Clerk of the City of Dunkirk.

SPRINGFIELD WATER-WORKS.

ADVERTISEMENT FOR PUMPING ENGINES.

Sealed proposals will be received by the Trustees of Water-Works of the city of Springfield, O., at their office in said city, until 12 o'clock noon, Tuesday, the 26th day of June, 1894, for furnishing and erecting complete in said city one or two pumping engines, each with easy current, capacity to pump 5,000,000 U. S. gallons of water per 24 hours to an altitude of 220 ft. for ordinary service and to the top of the stand-pipe, a total altitude of 260 ft above the surface of water in pump well, the source of supply through a line of 24-in. pipe approximately 13,000 ft., with two engines running. Proposals must state explicitly the kind or type of machinery offered, the duty to be guaranteed when pumping against a head of 270 ft. at the pumps, together with descriptive specifications sufficiently in detail as to clearly and correctly represent the material, method and mechanism of interior and exterior working parts, also such drawings as may be necessary to plainly represent the machinery in plan, elevation and sectional views. Bidders will also include the furnishing of all materials and constructing foundations complete for said machinery and appurtenances.

The trustees hereby reserve the right to reject any or all bids, or to accept such bids as, in their judgment, offer machinery best adapted to the service, and to that end the right is hereby expressly reserved to carefully examine, determine and be governed by the measure of economy in current performance of the machinery offered, its probable immunity from breakage or imperfect action, its durability, strength of working parts, thickness, sizes and weights of steam and water cylinders, journals and journal-bearings, pump plungers, steam pistons, length of stroke and piston speed. Also as to efficiency and acceptability of air-pumps, condensers, steam and water valves, receivers, together with any and all other working parts, and all parts in contact therewith or auxiliary thereto. Also as to perfections and particular mechanical designs, and the trustees further expressly reserve the discretionary right to accept such type of machinery as, in their judgment, aided by such expert testimony as they may elect to secure, will best and most permanently subserve the interest of the city of Springfield.

Subject to the express right to reject any and all bids. General specifications, forms of proposals and forms of contract will be furnished from and after the 11th day of June, 1894.

E. C. GWYN, Pres.
C. NAGLE,
CHAS. A. BAUER,
Trustees.

J. D. COOK, Toledo, O.,
Consulting Engineer.

Springfield, O., June 6, 1894. 24-2t

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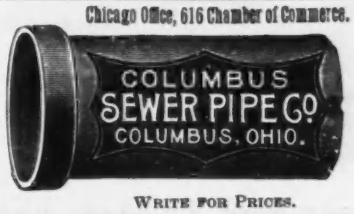

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TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., June 6, 1894.—Sealed proposals will be received at this office until 2 o'clock P. M. on the 6th day of July, 1894, and opened immediately thereafter, for all the labor and materials and fixing in place complete the low pressure, return circulation, steam heating and ventilating apparatus required for the United States Post Office Building at Fort Dodge, Iowa, in accordance with the drawings and specification, copies of which may be had at this office, or the office of the Superintendent at Fort Dodge, Iowa. Each bid must be accompanied by a certified check for a sum not less than 2 per cent. of the amount of the proposal. The right is reserved to reject any or all bids and to waive any defect or informality in any bid, if it be deemed in the interest of the government to do so. All proposals received after the time stated will be returned to the bidders. Proposals must be enclosed in envelopes, sealed and marked "Proposal for Heating and Ventilating Apparatus, Etc., for the United States Post Office Building at Fort Dodge, Iowa," and addressed to JEREMIAH O'ROURKE, Supervising Architect. 24-2t

TREASURY DEPARTMENT, OFFICE SUpervising Architect, Washington, D. C., June 5, 1894.—Sealed proposals will be received at this office until 2 o'clock P. M. on the 3d day of July, 1894, and opened immediately thereafter, for all the labor and materials required to put in place complete a hot water heating and ventilating apparatus for the U. S. Post Office Building at Lowell, Mass., in accordance with specification and drawings, copies of which may be had at this office, or at the office of the Superintendent at Lowell, Mass. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The right is reserved to reject any and all bids or to waive any defect or informality in any bid should it be deemed in the interest of the Government to do so. All proposals received after the time stated will be returned to the bidders. Proposals must be inclosed in envelopes, sealed and marked, "Proposal for Hot Water Heating and Ventilating Apparatus for the U. S. Post Office Building at Lowell, Mass.," and addressed to JEREMIAH O'ROURKE, Supervising Architect. 24-2t

OFFICE OF THE LIGHT-HOUSE ENGIneer, Seventh District, New Orleans, La., June 2, 1894.—Sealed proposals will be received at this office until 2 o'clock p. m of Tuesday, the 3d day of July, 1894, for furnishing materials and labor of all kinds necessary for the completion and delivery of the metalwork required for increasing the height of the tower at Key West, Florida. Plans, specifications, forms of proposal and other information may be obtained on application to this office. The right is reserved to reject any or all bids, and to waive any defects. JAMES B. QUINN, Major of Engineers U. S. Army, Light-House Engineer, Seventh District. 23-4t

TO PAVING CONTRACTORS.

Sealed proposals will be received by Committee on Highways of City of York, Pa., until 7 o'clock P. M., Tuesday, July 3d, 1894, for grading and paving four separate squares (approximately 15,200 square yards) with asphalt block or vitrified shale brick or block on 6-inch concrete foundation. Plans and specifications can be seen at City Engineer's office, No. 6 West Market street, York, Pa.

Each bid must be accompanied by a sample of block or brick to be used, also by a certified check of $500, drawn to order of City Treasurer of York, Pa., said $500 to be forfeited to City of York by bidder awarded contract in case he should fail to enter into within ten days after awarding.

The right is hereby reserved to reject any or all bids.

Bids are to be made out on blanks furnished at City Engineer's office and marked "Proposals for Paving." Address R. C. Boeckel, Clerk, care The P. C. Wiest Co., York, Pa.

By order of
JACOB HOSE, Chairman.

Attest.: R. C. BOECKEL, Clerk. 24-3t

HORNELLSVILLE, N. Y.

Sealed proposals will be received by the common council of the city of Hornellsville, N. Y., until noon of June 20th, 1894, for paving with vitrified brick Seneca, Canisteo and Loder streets. The aproximate amount of work to be done is as follows: 6,700 cubic yards of excavation, 16,430 square yards of pavement, 11,190 lineal feet of curbing. Plans and specifications are on file with the engineer in charge. A certified check for $1,000 must accompany each bid. For specifications or any further information, address the Engineer. The council reserves the right to reject any or all bids.

H. L. NASH, City Clerk.
F. W. DALRYMPLE, Engineer.

June 6, 1894.

THE STREET COMMITTEE of the city of Warren, O., hereby asks for plans, specifications and prices for the construction of a highway bridge over Mahoning River on South street at Warren, O. Bids must be received not later than July 1, 1894. For further information apply to WM. EATWELL, Chairman Street Com., or HOMER C. WHITE, City Engr. 24 2t

U. S. ENGINEER OFFICE, NEWPORT, R. I., May 30, 1894.—Sealed proposals, in triplicate, for stonework at Stonington breakwater, Conn., will be received here until 12 M. noon on July 17, 1894, and then opened. Attention of bidders is invited to Act of Congress approved August 1st, 1892, Sections 1 and 2 (Public No. 193). Full information furnished on application. W. H. BIXBY, Captain Corps of Engineers, U. S. A. 23-4t

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NOTICE TO WATER-WORKS AND ELECTRIC LIGHT CONTRACTORS.

Sealed proposals will be received by the Board of Water-Works and Electric Light Trustees of the Village of St. Bernard, O., at the Office of the Clerk of said Board, until 4 o'clock P. M., of Saturday, the 7th day of July, 1894, for the following items required in the construction of a system of water-works and the installation of an electric light plant for said village:

First. The furnishing and erecting of pumping machinery.

Second. The furnishing and erecting of boilers, engine, counter shaft, belts, etc., for an electric light plant.

Third. The furnishing and erecting of dynamos and apparatus for the production and operation of arc and incandescent lights.

Fourth. The furnishing and delivery of stop valves and fire hydrants.

Fifth. The laying of cast iron water pipe and the setting of fire hydrants, stop valves and appurtenances.

Sixth. The furnishing of material for the construction of a Stand Pipe Foundation.

Seventh. The furnishing of the material for and the erection of a Stand Pipe.

The proposals will be opened and canvassed by the Trustees at the above stated hour and place.

Each proposal will have to be accompanied by a cash deposit or a certified check for the following amounts:

For either the first, sixth or seventh item, $300.

For either the second, fourth or fifth item, $200.

For the third item, $500.

Said deposit to be made as a guarantee of good faith that the party making the proposal will, in five days, if the contract is awarded to him or them, execute the same with approved security, after which the sum so deposited will be returned to the successful bidder, and also to the parties whose bids are not accepted.

The certified checks deposited must be made payable to the Board of Water-Works and Electric Light Trustees of the Village of St. Bernard, Ohio.

The specifications and drawings will be ready for the work about June 22, 1894.

Copies of specifications will be furnished bidders upon application to the Clerk of the Board of Trustees or their Consulting Engineer, and the drawings can be seen at the latter's office.

The contractor for either part of the work will be required to give bond in an amount equal to the cost of same, to insure a faithful completion of the contract.

Bidders must indorse their names and addresses upon the outside of the envelopes containing their bids.

The Trustees reserve the right to reject any or all bids.

HERMAN J. WITTE, Pres't,
JOHN A. LARKIN,
HENRY IMWALLE,
Board of Trustees.

St. Bernard, Ohio, June 5, 1894.

GEO. HORNUNG,
Consulting Engineer.

23-3t 30 East 4th St., Cincinnati, Ohio.

JEFFERSON, IA., WATER-WORKS.

NOTICE TO CONTRACTORS.

Sealed proposals will be received by the City Council of Jefferson, Ia., up to 8 o'clock P. M. of July 6, 1894, for furnishing the materials and constructing a system of water-works for said city.

The works will consist of a 12 post steel tower 120 ft. high; a wood tank 30 ft. in diameter, 20-ft. staves, to be complete including frost proofing; about 1,120 ft. 10-in. pipe; 2,240 ft. 8-in. pipe; 3,300 ft. 6-in. pipe; 5,500 ft. 4-in. pipe; about 7,500 lbs. special castings, and 16 double hose hydrants.

Bids for furnishing and laying pipe must be per foot. Plans and specifications will be on file in the Mayor's office, Jefferson, Ia., and with the United States Wind Engine & Pump Co., Batavia, Ill., and Bankers Iowa State Bank, Des Moines, Ia., on and after June 10, 1894.

No bids will be received unless accompanied with a certified check on some responsible bank for $300, payable to the order of the Treasurer of the City of Jefferson, Ia.

Bids will be received for the whole or any portion of the above work, and the right is expressly reserved to reject any and all proposals or bids.

Dated at Jefferson, Ia., June 4, 1894.

HENRY HAAG, Mayor.

M. E. HALL, City Clerk. 24-3t.

For Other Proposals see Page XXI.

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THE COLUMBIAN EXPOSITION SALVAGE CO. (Incorporated),

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